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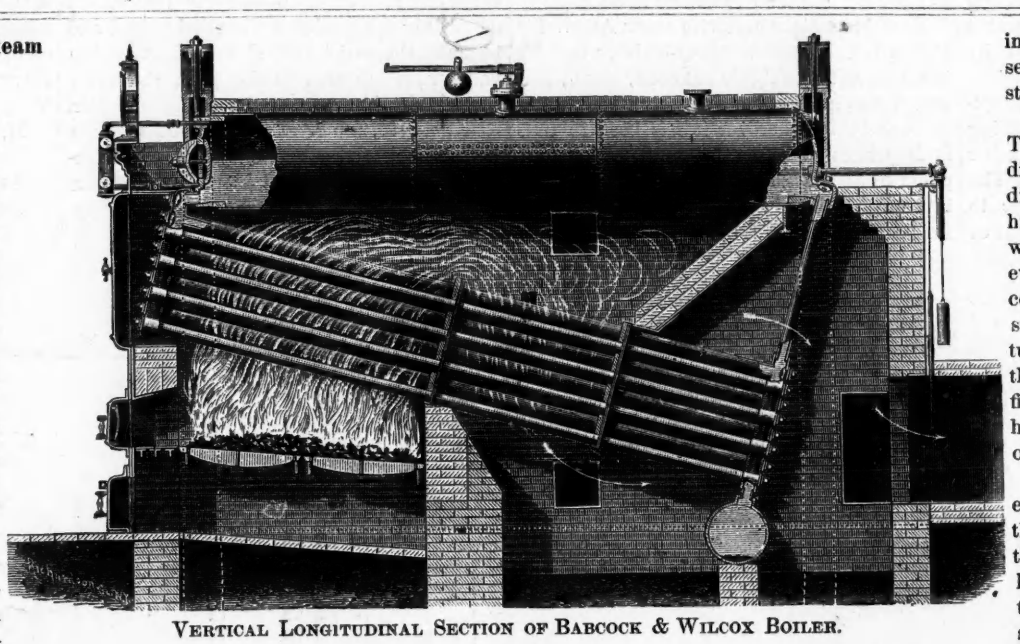
Babcock & Wilcox's Water Tube Steam Boiler.

Improvements in the generation of steam have not kept pace with improvements in the mechanism for using it economically, though observant engineers have long been agreed that the line in which such improvement was to be expected was in some form of the water-tube boiler. While our foreign contemporaries have been discussing the attempts which have been made to solve this problem in England, and pointing out the reasons why they are failures, together with the necessary elements of success, an American firm have been quietly working it out in practice, and now have in extensive use a plan of water-tube boiler, which contains in a practical mechanical construction all the elements which the most exacting engineer can ask for in a perfect steam generator. This may seem strong language, but let him who doubts it read the articles on this subject which have appeared in *The Engineer* and *Engineering*, of London, during the past ten years, and compare them with the boiler which we herewith illustrate, and they will acknowledge that we do not overstate the matter.

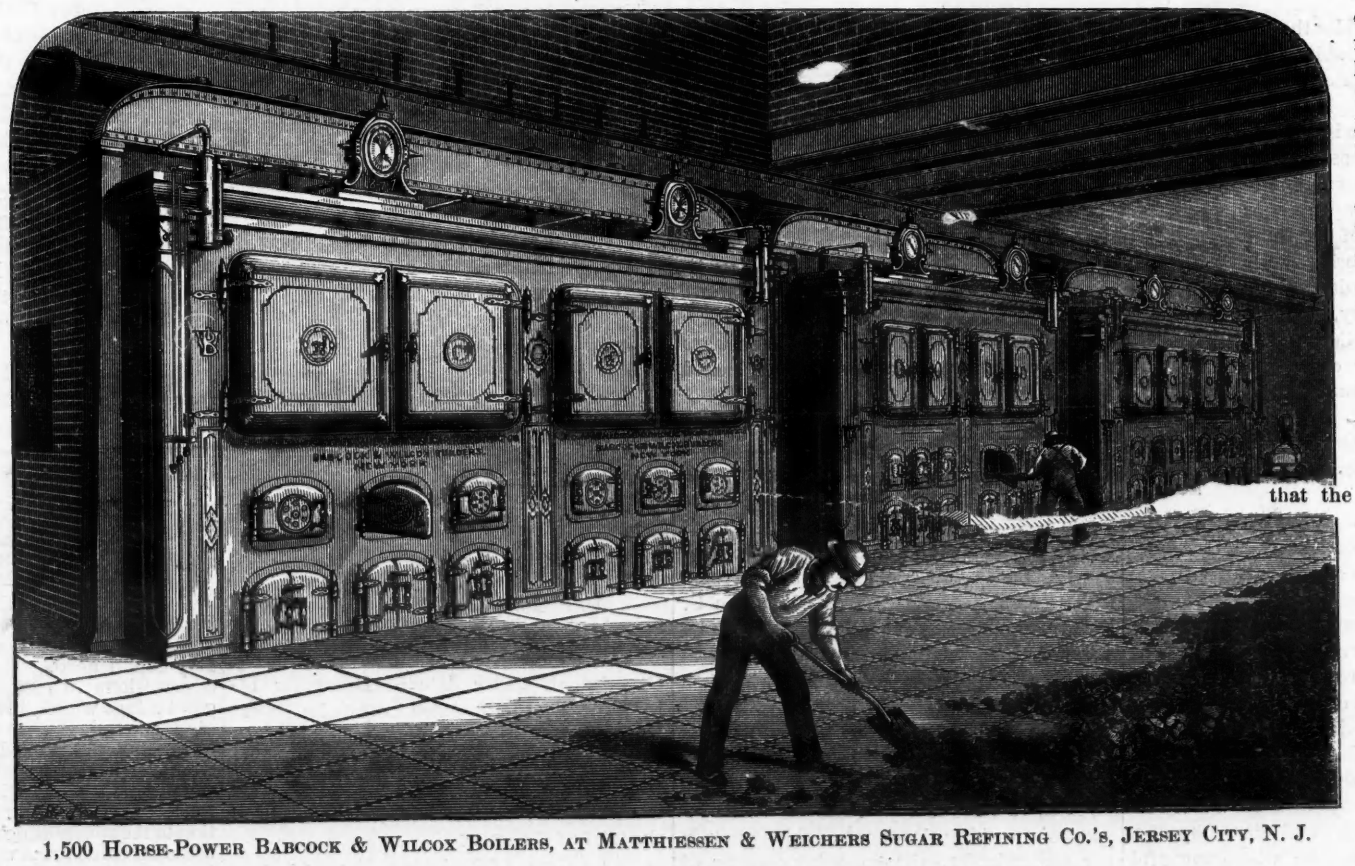


VERTICAL LONGITUDINAL SECTION OF BABCOCK & WILCOX BOILER.

DESCRIPTION.

This boiler is composed of *lap-welded wrought iron tubes*, placed in an inclined position and connected with each other, and with a horizontal *steam and water drum* by vertical passages at each end, while a mud-drum connects the tubes at the lower end. The tubes are "staggered" (or so placed that one row comes over the spaces of the previous row).

The *end connections* are each cast in one piece for each vertical row of tubes. The holes are accurately bored, and the tubes fixed therein by an expander. These are connected with the drum, and the mud-drum also, by short tubes expanded into bored holes, doing away with all bolts, and leaving a clear passage-way to each tube for cleaning. The openings opposite the end of each tube are closed by hand hole plates, the joints of which are made in the most thorough manner by milling the surfaces, and then accurately grinding them. These are tested and made tight under a hydrostatic pressure of 500 pounds per square inch, *iron to iron, and without rubber packing or other perishable substances.*



1,500 HORSE-POWER BABCOCK & WILCOX BOILERS, AT MATTHIESSEN & WEICHERS SUGAR REFINING CO.'S, JERSEY CITY, N. J.

In erecting this boiler, it is *suspended entirely independent of the brick-work or fire front*, from girders resting on columns. This avoids any straining of the boiler from unequal expansion between it and its enclosing walls, and permits the brick-work to be repaired or removed, if necessary, without in any way disturbing the boiler. All the *fixtures*, such as fronts, bearers, buckstays, etc., are extra heavy and of neat designs.

The fire is made under the front and higher end of the tubes, and the products of the combustion pass up between the tubes into a combustion chamber under the steam and water-drum; from hence they pass down between the tubes, then once more up through the spaces between the tubes, and off to the chimney. The steam is taken out at the top of the steam-drum near the back end of the boiler.

The water inside the tubes, as it is heated, tends to rise toward the higher end, and as it is converted into steam—the mingled column of steam and water being of less specific gravity than the solid water at the back end of the boiler—rises through the vertical passages into the drum above the tubes where the steam separates from the water and the latter flows back to the rear and down again through the tubes in a continuous circulation. As the passages are all large and free this circulation is very rapid.

ADVANTAGES.—The following are the prominent advantages which this boiler presents over those of the ordinary construction:

1. *Thin heating surface in furnace.*—The thick plates necessarily used in ordinary boilers, in the furnace, or immediately exposed to the fire, not only hinder the transmission of heat to the water, but admit of overheating, and even burning the side next the fire, with consequent strains, resulting in loss of strength, cracks, and tendency to rupture. Water tubes, however, admit of thin envelopes for the water next the fire, with such ready transmission of heat that even the fiercest fire cannot over-heat or injure the surface.

2. *Joints removed from the fire.*—Riveted joints with their consequent double thickness of metal, in parts exposed to the fire, give rise to serious difficulties. Being the weakest parts of the structure they concentrate upon themselves all strains of unequal expansion, giving rise to frequent leaks, and not rarely to actual rupture. These difficulties are wholly removed by the use of lap-welded water-tubes, with their joints protected from the fire.

3. *Large draught area.* — This, which is limited in fire tubes to the actual area of the tubes, in this boiler is the whole chamber within which the tubes are enclosed, giving ample time in the passage of the heated gases to the chimney for thorough [illegible] that the first opportunity would exami[illegible] the heat.

4. *Complete combustion.*—The current of gases after leaving the furnance are broken up and mingled by passing between the staggered tubes, and have an opportunity to complete their combustion in the triangular chamber between the tubes and drum.

5. *Thorough absorption of the heat.*—There are important advantages gained in this respect in consequence of the course of the gases being more nearly vertical to the heating surface, inpinging thereon instead of gliding by in parallel lines as in fire-tube boilers. The currents passing three times across and between the staggered tubes, are brought intimately in contact with all parts of the heating surface, rendering it much more efficient than the same area in ordinary tubular boilers.

6 *Efficient circulation of water.* As all the water in the boiler tends to circulate in one direction, there are no interfering currents,

the steam is carried quickly to the surface, all parts of the boiler are kept at a nearly equal temperature, preventing unequal strains, and by the rapid sweeping current the tendency to deposit sediment on the heating surface is materially lessened.

7. *Quick steaming.* The water being divided into many small streams, in thin envelopes, passing through the hottest part of the furnace, steam may be rapidly raised in starting, and sudden demands upon the boiler may be met by a quickly increased efficiency.

8 *Dryness of steam.* The large disengaging surface of the water in the drum, together with the fact that the steam is delivered at one end and taken out at the other, secures a thorough separation of the steam from the water, even when the boiler is forced to its utmost.

9. *Steadiness of water level.* The largest area of surface being at the water line, and the ample passages for circulation secures a steadiness of water level not surpassed by any boiler.

10. *Freedom for expansion.* The triangular arrangement of the parts forming a flexible structure, allows any member to expand without straining any other. The expanded joints are also amply elastic to meet all necessities of this kind. This is of great importance because the weakening effect of these strains of unequal expansion, between rigidly connected parts, is a prolific cause of explosions in ordinary boilers.

11. *Safety from explosions.* The freedom from unequal expansion avoids the most frequent cause of explosions, while the division of the water into small masses prevents serious destructive effects in case of accidental rupture. The comparative small diameter of the parts, secures, even with thinness of surface, great excess of strength over any pressure which it is desirable to use.

12. *Durability.* Besides the important increase of durability due to the absence of deteriorating strains, and of thick plates and joints in the fire, there is no portion of the boiler exposed to the abrasive action which so rapidly destroys the ends of fire tubes, or the blow-pipe action of the flame upon the crown sheet, bridge walls and tube sheets, so destructive frequently, to ordinary, particularly to locomotive boilers.

13. *Accessibility for cleaning.* This is of the greatest importance and is secured to the fullest extent. Hand holes, with ground joints, opposite each end of each tube, permit access thereto for cleaning, and a manhole in the steam and water drum, and bonnet in mud drum are provided for the same purpose. All portions of both the exterior and interior surface are fully accessible for cleaning.

If the above considerations were only theoretical, they would merit careful attention, but as they are the result of the practical use of many thousand of horse-power, during a number of years, and under a great variety of circumstances and treatment, they may be said to have been demonstrated.

No branch of industry furnishes a more severe test of the capacity and durability of a boiler than sugar refining; where powerful blowers urge the fires day and night, and sudden and enormous demand is made frequently upon the boilers for steam. The fact that the Babcock & Wilcox boilers are very extensively used in such refineries, and have been for the last eight years, and that every year they are displacing other kinds in this business, argues well for their durability and efficiency. Our cut represents a battery of 1500 horse-power of these boilers in the sugar refinery of Matthiessen & Weichers, of Jersey City. They are part of 2,000 horse-power in use in this single refinery, which, when in full blast, turns out over 3,000 barrels of refined sugar per day. There are eleven other refineries in the country supplied with these boilers. The Singer Sewing Machine Co., also have some 39 of them in use, amounting to nearly 3,000 horse-power, and there are many other sets in cotton mills, woolen mills, flour mills, paper mills, rolling mills, cement works, wagon factories, foundries, tanneries, bakeries, railroad shops, mines, and various other industries; in all of which they are giving particular satisfaction. Sixteen are now being built, seven of which are for the New Zealand Government, for their railroad shops, and one for Mr. Edison, for his new experimental shops at Menlo Park.

Ashcroft's Nickel-Seated Safety-Valve.

The most important attachmennt to a steam boiler is the safety-valve; if this is defective, or will not work properly, danger exists and it should be remedied at once.

The illustrations herewith show Ashcroft's Patent Nickel-Seated Safety-Valve, made by the Ashcroft Man'f'g Co., Boston, Mass., and which has achieved a very high reputation for reliability wherever it has been in use. It is perfectly automatic in its action, capable of discharging all the steam generated in a steam boiler in excess of a given limit. Its bearing surfaces being made of nickel cannot corrode, thus rendering it always reliable. If desired, the valve may be locked up.

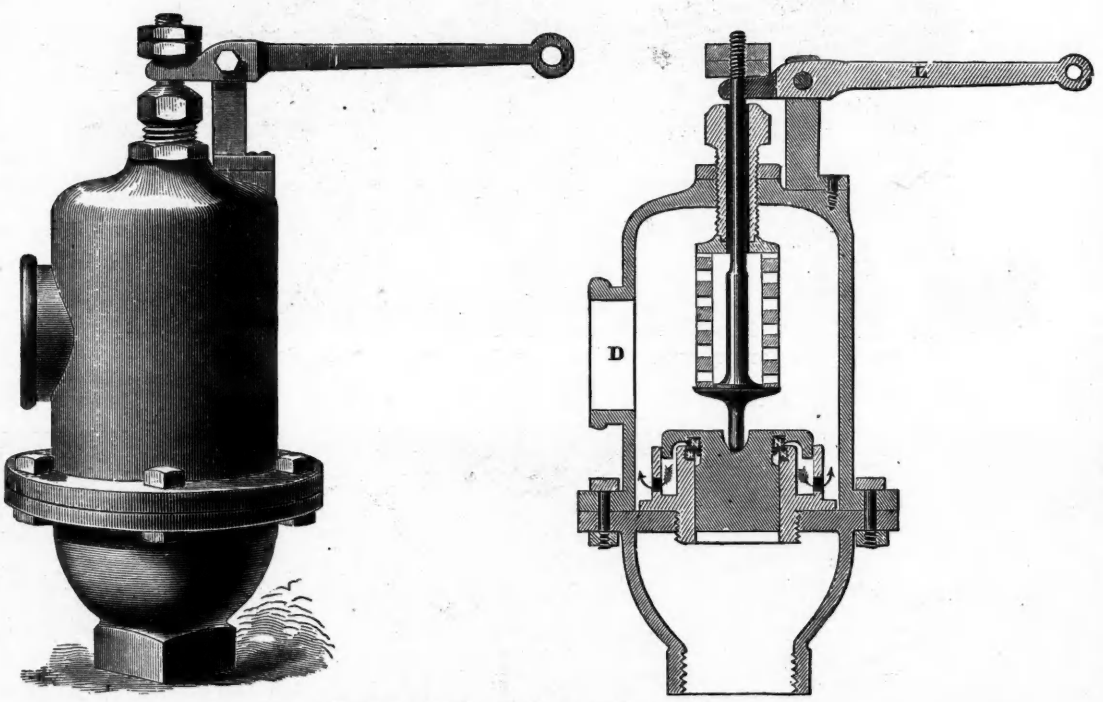
There is but little doubt that whatever may be the primary cause of boiler explosions, the immediate cause is an excess of pressure, which an efficient safety-valve might be depended upon to relieve. In this connection we shall refer to the results of some extensive tests made by the "United Railways of New Jersey," at which the U. S. Government was officially represented by a Board of Naval Engineers, detailed from the Navy Department. The following is a brief extract from their report:

"That, with only a wood fire, generating a far less quantity of heat in equal time than a coal fire, there were required only thirteen minutes to raise the pressure from the inspector's working allowance of thirty pounds per square inch to the exploding pressure of fifty-three and one-half pounds per square inch; showing that a few minutes' absence or neglect of the engineer, coupled with an overloaded or inoperative safety-valve, are all that are needed to produce the most destructive steam boiler explosion, even with an old and unequally braced boiler, in which it might be supposed a rupture of the weakest part would precede other fracture, and allow the escape of the pressure without doing further injury.

"That, in accounting for either the fact of an explosion, or for its destructive effects, there is no necessity for hypotheses of low water, enormous pressures, instantaneous generations of immense quantities of steam, superheated steam, the formation of hypothetical gases, development of electricity, etc. The most frigtful catastrophe can be produced by simply gradually accumulating the pressure of saturated steam to a strain at which the strength of the boiler yields; nor need that pressure be much above what is ordinarily employed with boilers of this tpye.

"That this experiment has conclusively disposed of several theories of steam boiler explosion, replacing vague conjecture and crude hypothesis with exact experimental facts, and, by thus narrowing the field for the search of truth, has made the discovery more probable."

The ordinary safety-valve as now constructed consists of a disk which closes the outlet of a short pipe leading from the boiler. The real diameter of safety-valves must be greater than the theoretical orifices, because common observation shows that valves do not rise appreciably from their seats, and to make the outlet around the edges of the valve equal in area to the pipe, the valve should rise quarter of its diameter. On steam vessels, too great care cannot be taken with the safety-valves. We include herewith a report of Board of U. S. naval officers on Ashcroft's Patent Nickel-Seated Safety-Valve:



Ashcroft's Nickel-Seated Safety-Valve.

Boston, Mass., January 13, 1876.

Engineer-in-Chief, W. W. H. Wood,
U. S. Navy.

Navy Department, Washington, D. C.

Sir:—In obedience to the order of Navy Department, under date of December 14, 1875, the Board appointed to test the Patent Nickel-Seated Safety-Valve, in comparison with those ordinarily used on the boilers of United States Naval vessels, met on the 12th inst., at Lynn, Massachusetts, and completed the trial of the same.

The valves, of 2½ inches diameter, were of the size most approximate to the dimensions of the boiler; and it will be seen by reference to the above (refers to various pressures at which the valves were tested) that the pressure of steam, on both the low and high pressure test made with the ordinary lever valve, rose 11 pounds above the point at which the valve commenced to blow off, while, with the patent valve, it only rose 1½ pounds on the low pressure, and one pound on the high pressure trial.

The efficiency of the nickle-seated valve was especially noticeable on the final trial, when the valve opened and closed ten times in ten minutes, and maintained the steam over active fires between sixty-nine and seventy-one pounds.

The Board, therefore, have to state, in answer to the first interrogatory of their instructions, that the nickel-seated safety-valve is in every way more efficient in its operation to free the boiler from accumulating pressure.

In answer to the second interrogatory, regarding the relative promptness, the patent nickel-seated safety-valve is in every way superior in opening and closing.

Regarding the third point of their relative tendency to become inoperative from setting fast, etc., the Board are of the opinion that the use of the patent nickel seat possesses the very important advantage of lessening the liability of the valve to set fast in its seat.

In conclusion, the Board are of the opinion that the addition of this valve to the boilers of the United States Naval vessels will add to their safety and efficiency, and it is recommended for use, and as especially necessary on the high pressure boilers of the compound engines recently built by the Navy Department.

Very respectfully, your obedient servants,

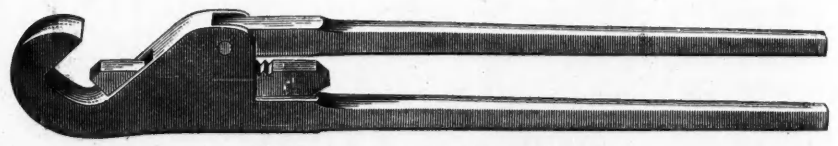
H. H. Stuart, *Chief Engineer*,
President of Board.

Alexander Henderson, *Chief Engineer.*

David B. Macomb, *Chief Engineer.*

Barnes' Adjustable Pipe Tongs.

We show herewith a new adjustable pipe tongs, forged from wrought iron and cast steel. They are manufactured by M. E. Frog Co., and are sold by H. Prentiss & Company, 14 Dey street, New York. The following are the special advantages claimed: 1st. They can be quickly adjusted to fit five sizes of pipe. 2nd. They are simple in construction, and not liable to get out of order. 3d. They possess great strength and no one need have any fear of breaking them. To use the tongs throw back the lever handle as far as possible with the *right* hand, holding the tongs with the left hand under the sliding jaw, with the thumb *press down* the sliding jaw, moving it *to the mark* on the *left* hand side of the jaw, representing the size pipe you are using; then bring the handles together, and the sliding jaw will engage the pipe. If the handles come too near together to suit you, *move the jaw one notch* or more.



Barnes' Adjustable Pipe Tongs.

Machine Tools.

For machine tools there should be a growing demand in exact proportion as the competition of foreign manufactures is disagreeably experienced. These tools have enabled our workers in metals to accomplish the great things which, in steam machinery, have distinguished the present generation; they have, indeed, enabled the manufacturers in whatever line of business, to largely dispense with the tiny tool wielded by the comparatively unskilled workman. We direct attention to the sphere which is widening out before those machine firms who are adepts in devising apparatus to cheapen the manufacture of domestic metal wares. The hardware makers will be growing customers to the mechanical engineer. The former will be utterly unable, by hand-made products, to continue to compete with foreigners who use machinery. The machine-made goods will still run down prices, and it may be attempted to meet the competition by a reduction in the remuneration paid for manual labor. But already there are indications that pretty much the limit of endurance by the handcraftsmen has been reached. Our work people have not yet abandoned all opposition to machinery, but it is every year less displayed. If the manufacturers of locks and files, and nails, are now customers to steel-tool-making firms, the manufacturers of cutlery and kindred goods must begin to seek the help of mechanical engineers, if they are not to be jostled out of the many markets in which they have done profitable business.—*The Engineer.*

The Hub Friction Clutch.

The accompanying illustrations show a new form of friction clutch, manufactured by the Hub Friction Clutch Company (Limited), 417 Race Street, Philadelphia, Pa. This clutch differs from the clutches in general use in applying the friction to the hub instead of the circumference of the pulley. By this means irregularity of wear is avoided and the hub of the pulley is supported. This clutch can be applied to any pulley or used in place of a coupling for detaching lines of shafting. In size they are made in great variety, from those applicable to pulleys with one inch hubs up to those capable of transmitting 500 or 600 horse-power. Fig. 1 represents a counter shaft and pulleys for driving lathes, screw machines, &c., which require the motion to be reversed quickly or gradually, as the case may be. By varying the motion of the shipper, working it quickly to start light machinery and slowly where heavy machinery is to be started or reversed, the clutch can be made useful for a very wide range of work. Fig. 2 is a "cut-off coupling" used for connecting or disconnecting lines of shafting without stopping the engine or motive power or slacking speed. It can also be used for connecting auxiliary steam engines and water wheels so as to use them independent or connected. It may, in fact, be used in a variety of positions where heavy machinery has to be started and stopped, and where it is not desirable to keep long lines of shafting in motion constantly. In Fig. 2 A A are the ends of the two shafts, which come together in the center of coupling at A; H is the hub, which is made fast to the end of one of the shafts A; S is the shell, which is made fast to the end of the other shaft A; R is the split steel ring (shown in Fig. 3, a section of the cut-off clutch which is fitted to the inside of shell and made fast to it and into which the hub H is made to fit loosely. The steel ring is made to clasp the hub by means of a tapering wedge, W, which draws the ring together when the sleeve C is moved forward on the shaft, causing the adjusting screw T in end of lever to press the wedge downward. Figure 4 represents a pulley and clutch, the clutch being applied. The dotted lines show the position of the cone when the clutch is thrown off. Figure 5 represents one of the clutches, shown in Fig. 1, without the pulley, and the double cone used for double clutches. Figure 6 represents a section of a clutch suitable for application to a pulley. It will be seen that by forcing down the wedge the friction ring is made to grasp firmly the hub of the pulley. These clutches are for sale by H. S. Manning & Co., 111 Liberty Street, New York.

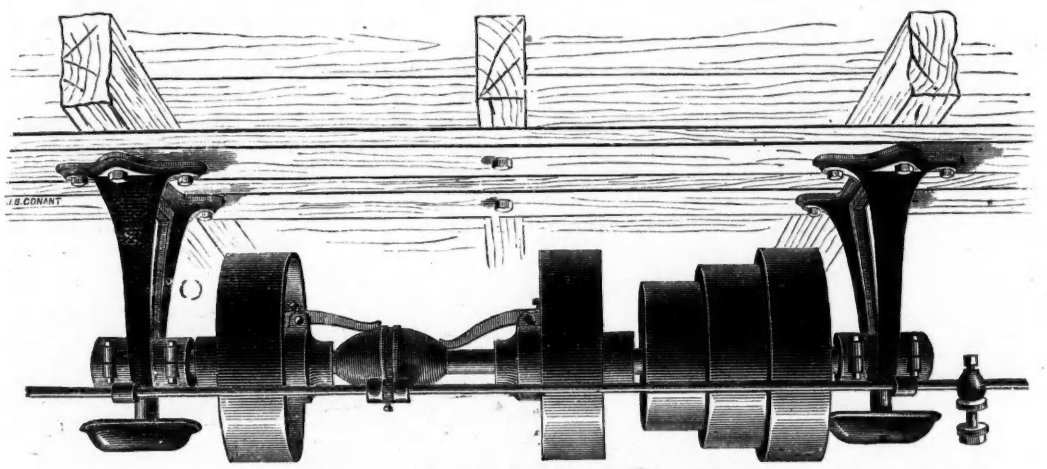


Fig. 1.—Counter Shaft and Pulleys.

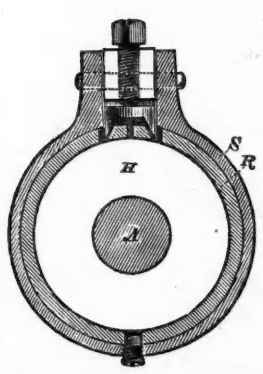


Fig. 3.—Section of Cut-off Clutch.

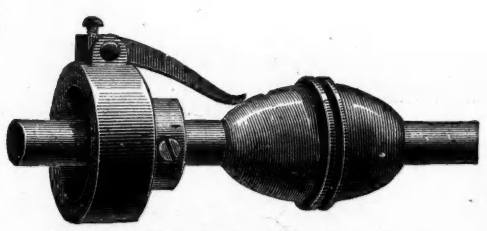


Fig. 3.—Clutch and Double Cone.

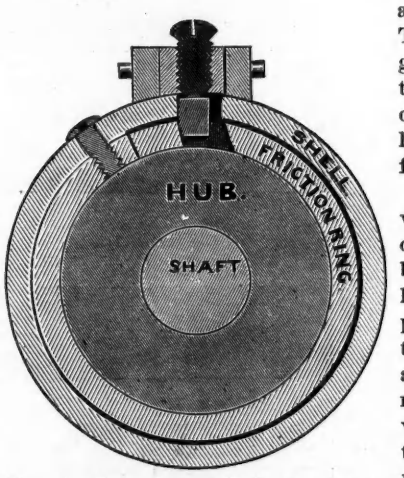
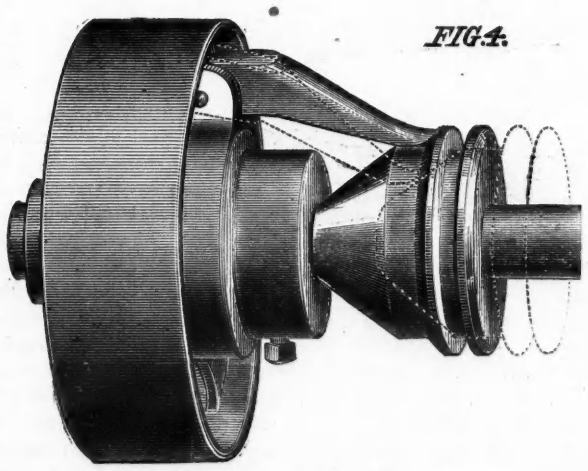


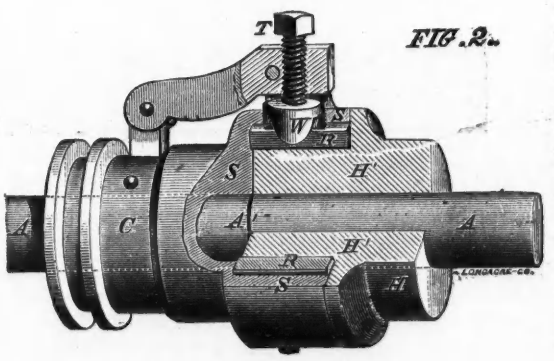
Fig. 6.—Section of Clutch applied to Pulleys.

FIG. 4.



Clutch and Pulley.

FIG. 2.



Cut-off Coupling Clutch.

The Hub Friction Clutch.

During August, there was held a National Microscopical Congress, at Indianapolis, Indiana, and it was there decided that the 1-100 m m should be the unit for microscopic measurement in this country hereafter, in place of the 1-1000 of an inch in common use. In accordance with a resolution passed by the Congress, the New York Microscopical Society is taking steps to secure a true division of the m m for a standard.

Benjamin Atha & Co., of Newark, manufacturers of file, spring and tool steel, are extremely busy running double time.

The Starter and Stopper.

BY STEPHEN ROPER, ENGINEER.

The proprietor of a large cotton mill in Philadelphia, discovered, one morning, to his surpise and horror, that his engineer was dead—dead d——k; and being anxious to replace him as soon as possible, he inquired of his hands if any of them knew of an engineer that he could hire. He was informed that there was actually in that neighborhood, a man who claimed to have run all kinds of engines, both on sea and land. When sent for and asked where he had been employed last, he answered in the far west; and as he accidentally left without any written recommendations, and at least a week would elapse before a letter would reach his last employer and return, he suggested that it might be better to let him take hold immediately. As the proprietor of the factory had orders to fill, he acquiesced in his views, and told him to take charge. Accordingly, he donned the blue overalls and jumper with the air of a man who knew his own worth. Soon after starting up he heard a squeaking in the cylinder; and as he probably never saw the interior of a cylinder, and knew nothing at all about the mechanism of a piston, he was puzzled to know what the trouble was. He consulted a friend, probably a person who knew less about it than he did himself, which was quite natural, as such persons generally have an aversion to consult intelligent engineers on subjects on which they desire information. His friend suggested to him that the packing in the cylinder was either too tight or too slack, and by using a quantity of tallow he would probably discover the cause of the noise. After the tallow had been used plentifully for a short time, the noise stopped, and in order not to be troubled so again, he used a barrel of tallow, 300 pounds, in 15 hours. The second night when he stopped, it being hard freezing weather, the tallow congealed in the exhaust pipe, and when he tried to start next morning the engine would not move. He then took off the bonnet of the steam chest, and the back cylinder head, and could not see *anything* wrong. A practical engineer was consulted, and made the discovery that the exhaust pipe was filled with tallow, and that every spring in the piston was loose. The stopper and starter was advised to apply for a patent on his simple method of setting out piston packing with tallow, and by way of securing his invention it was suggested that he immediately file a caveat; but the owner of the steam engine cut the thing short by ordering him to file out.

A country chap, who evidently knew nothing at all about a steam engine, but was anxious to run one, answered an advertisement for an engineer in a glass factory. He knew he was capable, as he saw engineers sitting in arm chairs while their engines were running. Of course he could do it! an old woman could do that! He was a great talker, in fact he had a double hinge to his under jaw. He was engaged, and proceeded to get up steam. When the gong sounded for starting he had not sufficient steam up, so he left the engine standing with the crank on the dead centre, and the throttle valve wide open, while he fired up with wood. On some of the hands informing him that he had plenty of steam to start, he placed both feet on one of the arms of the fly wheel, in order to pull the engine off the centre, when it immediately started, and knocked him head foremost into a well containing 25 feet of water, from which he was fished with some difficulty, after which he beat a hasty retreat from that neighborhood.

A miller in New Jersey advertised for a man to run an engine, work in the garden and milk a cow. A person made application for the situation that had no papers, but wore a checked shirt, and sported a very heavy brass watch chain; these he considered stronger evidence of his ability than a volume of written recommendations. He had run a great many engines in his time, generally in the west, some of them of tremendous calibre and added that they were all in wretched condition when he took charge, and when he left them they were all in the most perfect order. In fact, he set all their valves. He was employed, of course. Shortly after he took charge the govern or belt broke, and the engine increased its speed very rapidly. He became excited, and instead of shutting off the steam at the valve, he rushed into the yard, picked up an oak timber 6x8, and thrust it into the fly wheel. This of course stopped the engine, and at the same time broke the fly wheel and the bed-plate off at the pillow blocks. He had a peculiar way of his own for stopping the machine.

The owner of a small engine was unable to get the amount of work out of it he desired; he became dissatisfied, discharged his regular engineer, and employed a stranger who asserted that he could take more out of an engine than any other living man. Besides, he could run it with half the amount of coal that any other engineer would require. He was somewhat like the Irishman who was advised by a stove dealer to buy a new pattern of stove, as it would save half the coal. Pat suggested that it would be better to buy two and save it all. He was engaged, and the proprietor of the mill suggested to him that the first opportunity he had he should examine the piston and see if the packing was tight in the cylinder. He did so, and screwed it up so tight that when he attempted to start the engine it would not move, even under a full head of steam. Some of the hands suggested that perhaps the cylinder was too tight, meaning the piston, of course; he took the hint, unscrewed the nuts which held the cylinder to the bed plate, and then called several of the employees to turn the balance wheel around. The engine started and knocked the cylinder off on the floor, breaking out the front cylinder head, piston rod and steam pipe. He could start and stop her.

A German, calling himself an engineer and machinist, was employed by a countryman of his own to run an engine. The engine was an old one; the yoke on the slide valve was so much worn that whenever the steam was shut off the valve fell away from its seat, and when steam was again applied, it entered both ends of the cylinder at full boiler pressure. Of course the engine would not move until the balance wheel had been turned around several times. The engineer made every effort he could think of to start, but all in vain; and, as he could neither

speak nor understand the English language, he could not communicate his distress to anyone. He became excited, and in his desperation he picked up an axe, and dealt a powerful blow on the bonnet of the steam chest; the jar of which seated the valve, when the engine started immediately. The *engineer* was relieved of his embarassment, and was convinced that that was the way, and the only way by which to start the engine. The next time he undertook to start, the engine did not move under the first blow, he therefore applied more muscular force to the axe, the result of which was that it flew off the helve, and into a cesspool that contained over 6 feet of mud, and as there was no extra axe on the premises, it was sometime before he got underway.

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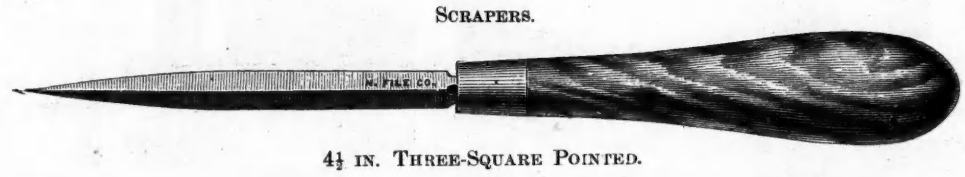
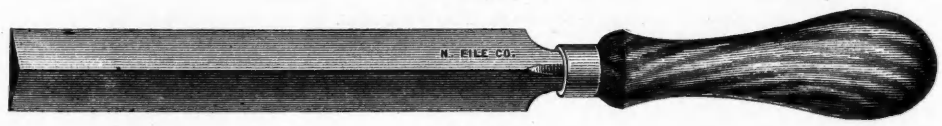
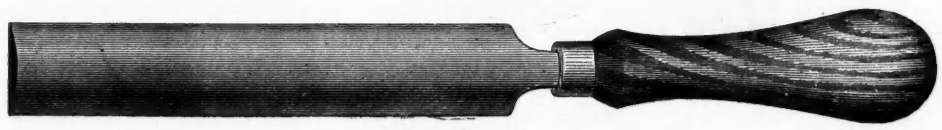


4½ IN. THREE-SQUARE POINTED.



6 IN. CANT.

10 IN. ROUND.



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4 IN. THREE-SQUARE.

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I promised you a story with figures in it. Here it is: Twenty-two years ago, Sherman Sackett and William Wycoff completed their apprenticeships at the Novelty Works. They worked on three months as journeymen, and then, as journeymen, they tramped. They were both, in the ordinary sense of the word, good workmen, and both stood equal on the pay books. They tramped at the same time and with equal resources, viz.: valise full of clothes for outfit, and ball pein hammer for plant. They passed through the vicisitudes usual in the life of tramping jours, job after job, shop after shop, year after year. When this stopped, I do not know, but Sackett is now the mayor of a town, the owner of a shop, and the employer of sixty men. Wycoff also has a shop and employs fifty men. They seemed to have prospered. The fact is, they struck rich veins of work, of which, more anon; they entered untouched ripened fields as reapers when almost tired with seeking.

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He now invited proposals for 5,000 machines. Wycoff bid as follows: "Will make 5,000 machines for $24 each, 100 machines per week, payments weekly." Here is Sackett's bid: "Will make 5,000 machines for $8 each, 1,000 machines per week, payment on completion of order."

If there was anything strange about the bills, there is something stranger about these bids. The two men have about the same capital invested in exactly the same line of business, and their tools are nearly identical, and their shops are not a mile apart.

Wycoff's wanting money weekly is accounted for by the fact that he had no loose capital and could not carry the job. But what caused the difference between 100 machines per week and 1,000 machines per week, and what caused the difference of 200 per cent. in price? I will say, right here, that Sackett got the order and filled it, and has filled several more like it since Knowing the men as I do, I can give the reasons for their great difference in bills and bids. The fact is there is over 200 per cent difference in the men as manufacturers. Wycoff, in the first place, didn't know, when he "estimated" on the samples, what it would cost to build the three machines, he guessed at it. He didn't know what they cost after he did build them, he guessed at that. Guessed he had made money on them, and guessed he could afford to shorten up on the profit on a large order. It happened, however, that the larger order "guessed not." My own opinion is that if he had received the job at $24 each he would have lost money. Around his entire premises there is nothing to show what anything ever did cost, except raw material. It is a good thing, it saves old bills. He keeps books, of course; and knows all about his debts and credits, but nought else.

Now it happens that Sackett, our successful bidder and successful manufacturer, carries in his hat the brains of a systematic manager. His estimate on the first three machines was not guessed at, but was carefully calculated from the nearest parallel cases he could find in his prime cost books. When the machines were done, he found things about as he had expected, and by carefully watching details, had already mapped out his plan of operations and system of production, which would enable him to make these machines in great quantities and at low price. There was nothing surprising to him in the difference between the first three machines, and those he subsequently made; while in Wycoff's case, I do not think there would have been much difference.

The difference between Sackett and Wycoff, as manufacturers, crops out all over. Sackett employs good men at good wages and keeps them. Wycoff employs good men at good wages and can't keep them. There is something in the atmosphere of Wycoff's shop which seems to deprive a man of his self-respect, which is, in reality, the mainstay, sheet-anchor, and only hope of the workingman. Wycoff puts much trust in rules and regulations. You will see a string of them, as long as your arm, as soon as you enter the shop. They are frequent on the walls, supplemented, occasionally, by an enlarged edition of some particular one, thought worthy of a separate frame. One may be noticed with the attractive and endearing legend, "We expect a day's work for a day's pay." Wycoff stole this thing somewhere, for there is no "We" in the concern.

I once saw a body of men on a strike. They had been getting $4.00 for six hours' work, and demanded $6.00 for four hours' work. This was many feet below the bottom of the Mississippi river, where the air was compressed so much that the workmen who were at all damaged by it were thrown into what the bridge hands called the "Grecian bend." When the bent ones straightened out it was often permanently. But, of course, this is not appropriate. Wycoff's men didn't have to work in a compressed atmosphere. Oh no!

Take a trip through his shop. The tools are generally modern and good, but wretchedly kept, and we see no waste that looks as if it would clean anything. Yonder's a chap turning what appears to be a throttle-stem, for it has an elliptic button on one end. He is taking a water-cut over it, and that white lead keg, blocked up on the lathe carriage, bears a striking resemblance to the one we saw over the north grindstone. Those earmarks of grindstone grit make the matter certain. Here's a bench or counter in the middle of the shop, and on it some finished work, a chuck or two, an island of horrible looking waste, half a dozen flat drills and a piece of a twist drill, and here lies a tap, clean and nice, and we pick it up and examine it. We see at once that it is home-made, but it is a beauty, clean-cut and neat. You find it impossible to help admiring this simple tool, for you have made a tap or two yourselves, but none so perfect as this. We lay it down and go on through the shop. Next week you may see the dismembered fragments of our tap in place of its present misplaced perfection.

Here we find Wycoff, coat off and honestly greasy. Yes, he does keep a foreman, or tries to, rather; kings without thrones. "Ah! Mr. Chordal, how do you do? Happy to meet you Mr. Miller, and you Mr. Bailey, excuse my gloves; belong to the laboring classes, you see. Look busy, eh? should think I was; got enough work to—excuse me, gentlemen, got to shrink this crank on." We now notice that just in front of us, on trestles, lies a six inch shaft, with an end projecting. And now, upon the scene, through the blacksmith-shop door come four men, whom I know to be the best paid machinists in the shop, bearing a thirty-inch crank-plate, glowing hot. They quickly place it in position to start on the shaft, and proceed to urge it. From the time Wycoff left us he has not ceased to speak or excitedly yell over this job. We know a single yell will spoil a shrinking fit, but Wycoff, probably don't know it. Now an excited order to one man to go for that block; to this man to raise up; and to that one to let down, "damn it;" now a snub to the man who is really responsible for the job; now he franticly grabs a sledge and strikes a lick or two; now at something else. Every word spoken seems to be immature, every action a false one. We walk on. You remark that Wycoff don't seem to be a cool man, and that if you had any money invested in that crank you would prefer to entrust the job to the jour. whom W. just snubbed, and who seems to have lost all interest in the proceeding, simply looking on with servile disgust.

It's a habit of Wycoff's to take all such jobs into his own hands, generally nipping them in their fruition. The crank was all right, but it is now stuck half way and tomorrow they will try to get it off again.

We go over towards a new engine on the floor, when in come four men with a twelve-foot shaft, red hot. They go over to the long lathe. Up goes the shaft on the blocks; now up on the centers; now it is revolved and gets chalked; and now it comes out and gets pounded and dented, and in two hours it will get straightened. Two hours of what? Lathesman, 60 cents; two blacksmiths, $1.20; one helper, 20 cents; total, $2.00 plus two fires and a lathe standing still, and—those hammer marks.

We go on over to the before-mentioned engine; it's about half done. You ask if Trumbull didn't furnish the castings. No; but he furnished the design. Wycoff's pattern maker measured one of Trumbull's engines and made these patterns from those measurements. There is no drawing in the shop for any part of it, not a memorandum even. The "copy" is in a mill about a mile from here, and Wycoff's foreman has made over thirty trips so far to take a look at details The Lord only knows how many trips it will take to finish it, but we know that it will take just as many for the next engine, and the next. We know what a set of drawings would cost, but no man knows what this engine will cost, or will not cost. We leave it.

Here's a planer, splendid tool! Bement's; but Bement wouldn't recognize it. The table don't look like a planer table at all. Seems as if the prismatic rays from a spectroscope had fallen on this table lengthwise, and on these rays have fallen crosswise; hammer marks, and chisel marks, and sand marks, and water, and oil, and soap, and chips, and dirt. It is not so all over, however, for there a small place has been cleaned, and that new job will soon be fastened there, if Gus can find suitable bolts up among the lathes. You knew Gus when he worked at the Empire Works. He was not such a miserable slouch then; he was a good workman, and you wonder if his skill is not endangered by his present habits. I can tell you, his skill is now a total wreck. He worked for me long ago, and left W. once and came to work for me again. I sent him back. He seemed to be two different men. He gets good pay and will as long as he stays here, but his pride of skill and his self-respect have gone forever.

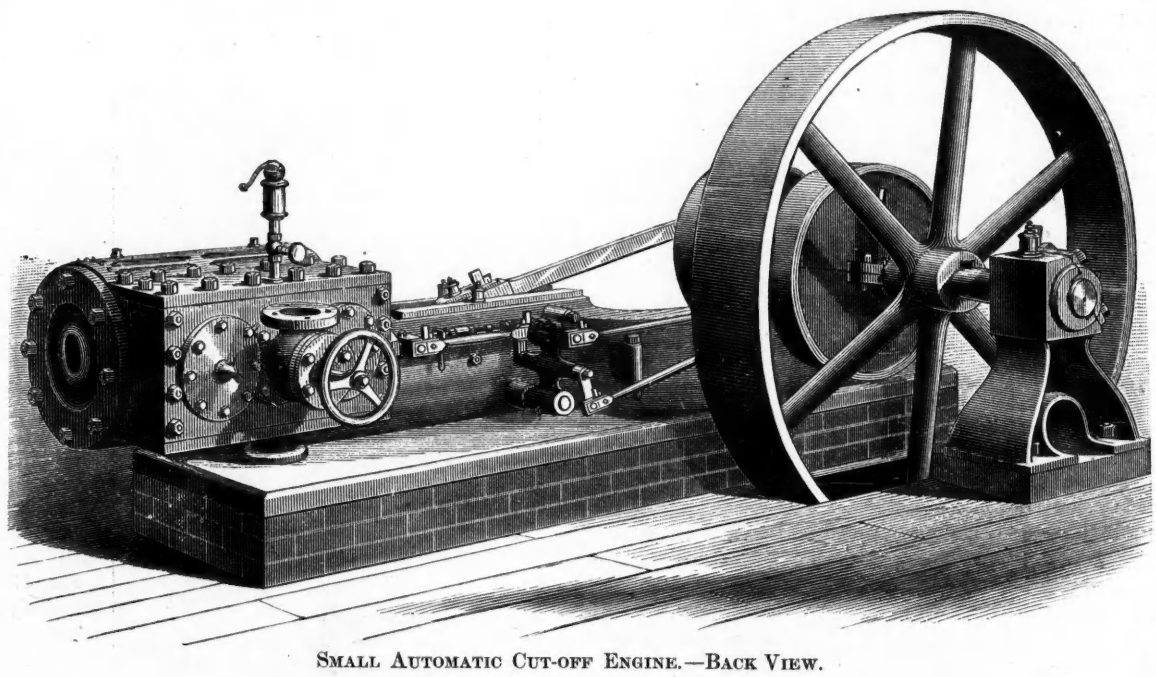
You have an eye for the tool holders or clamps on this planer. Three nuts of one size, and one nut of three other sizes. You look to see what manner of universal wrench Gus uses for a tool wrench. Finally, you spy it; a monkey wrench. Strange, but you hadn't thought of that. Now we go into the foundry. Notice that the only way to get into the foundry is through the machine shop, and the only way for the castings to get out of the foundry is through the machine shop, which we find littered up with lamp posts, grate bars, sash weights, spout guards, in fact, an index to the foundry order book. Here we are in the foundry. Here's a facing mill, and a Sturtevant blower, and a rattler within six feet of it, showing little regard for the lungs of the workmen or the journals of the blower. There's a man cleaning off a sugar mill roller. Know him do you? No, he is not a cleaner, but a well-paid machinist. We see they intend to take off a heat soon; let's go. We don't want to see Wycoff at work in here. He will come in when the iron comes down, will bring the best men out of the machine shop with him, will tap out, and skim, and riotously work mud on the end of the plugging stick, and yell and swear and superintend generally. His foreman is a well-paid man, but helpless. If Wycoff kept cost books he should *credit* the foundry with his services at five dollars per hour.

We go out—past the planers, past the Wycoff engine, past the whole committee on mean ways of straightening shafting, past the half way crank and its pondering factors, past our beautiful tap—out from under the garish rules and into the street.

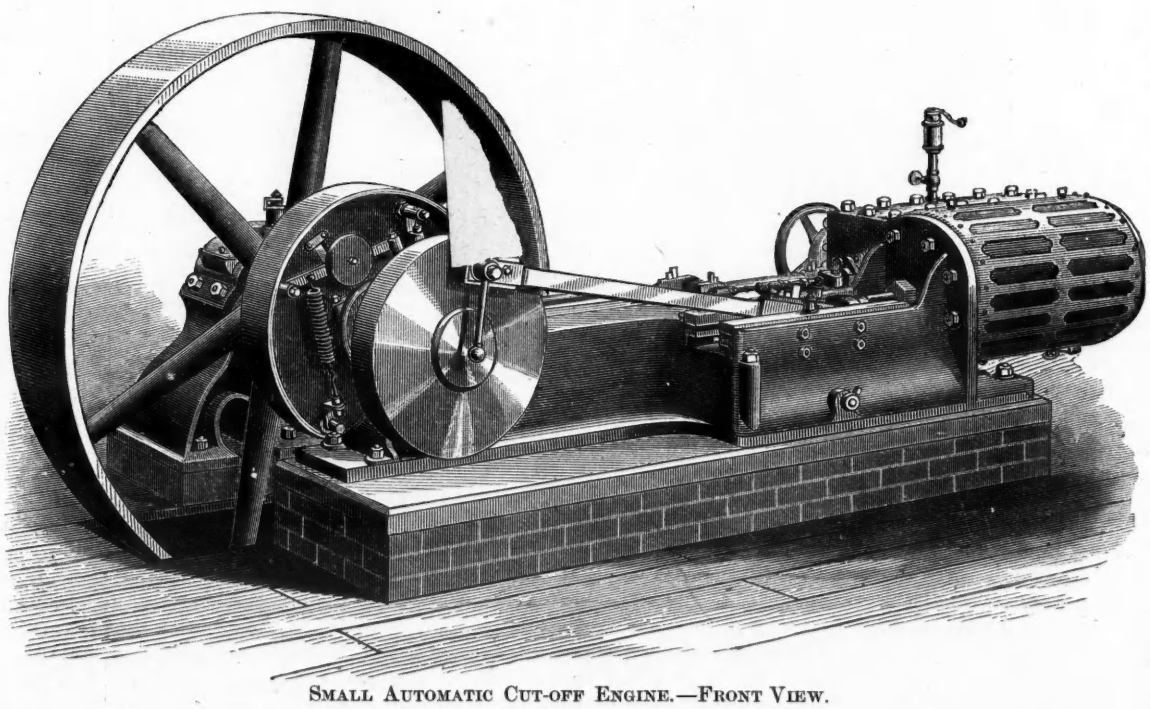
We will see Sackett's shop some time and many times. His interior, his processes, his men, his management, will all furnish material for instructive mention in these letters some day.

Very respectfully,

CHORDAL.



SMALL AUTOMATIC CUT-OFF ENGINE.—BACK VIEW.



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Small Automatic Cut-off Engine.

We illustrate on this page the small automatic cut-off Engine from 10 to 40 h. p., built by the Buckeye Engine Co. of 87 Liberty St. These small engines differ from the larger ones only inthe form of bed (see engraving in our May number)the valve motion is the same throughout, consequently equal economical results per h. p. together with close governing, is maintained in both types. We learn they are received with much favor, and are giving excellent satisfaction. There are not a few instances where the ordinary throttling and automatic cut-off Engines having ridicuously light loads, use fully 10 lbs. of coal for each h. p. developed per hour. These small automatics will do the same work with about one-third of that quantity, and the saving of two-thirds or even one-third of our coal bills is of considerable importance in these times of small margins incident to all classes of manufacturing. These engines have the advantage of moderately high piston speed—about 500 ft. per minute—combined with the benefits of using steam expansively and automatic regulation. As they occupy but little floor space compare with the ordinary engine of equal power, and being nicely balanced they are very well adapted for use on upper floors, and wherever room is limited. They are unusually well built, are simple in construction, easily cared for, and fully up to the acknowledged high standard of the Buckeye Engine, now so popular in this market. Two of these engines, one small of 15 h. p. and one of 80 h. p. are now on exhibition at the fair of the American Institute, now open in this city.

New Publications.

We are indebted to Prof. R. H. Thurston for a copy of his REPORT ON COLD ROLLED IRON AND STEEL AS MANUFACTURED BY JONES & LAUGHLIN'S AMERICAN IRON WORKS, PITTSBURGH.

The work contains 109 pages, also a number of double page plates. It embraces the results of very extensive tests to determine the value of cold rolling, the conclusion being that it increases the tenacity from 25 to 40 per cent., and the resistance to transverse stress from 50 to 80 per cent. It also elevates the elastic limit under torsional as well as tensile and transverse stresses, from 80 to 125 per cent. It also improves the metal in several other respects. The work before us will be of especial interest to all those interested in metallurgical manipulations.

THE AMERICAN QUARTERLY MICROSCOPICAL JOURNAL, edited by Romyn Hitchcock; Vol. 1, No. 1, October, 1878.

We have received the first issue of the above quarterly, which is published in the interests of microscopical science. It is a well printed 82-page magazine, with an additional 16 pages devoted to the transactions of the New York Microscopical Society. It is embellished by a number of fine plates, and its articles are the best of their class. Among the articles in the issue before us we notice "The Sting of the Honey Bee," by J. D. Hyatt; "Description of a New Species of Diatoms," by H. L. Smith, and many others. The magazine is published by Hitchcock & Wall, 150 Nassau street, New York.

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Two years ago a certain patentee, acting on my valuable advice, took both Sackett and Wycoff a sample of his machine. I say machine, but the following figures will show that it was a very trifling affair, but of such products is the kingdom of industry. He gave each an order for three machines, with no stipulations as to price, his object being to secure samples of their work, and to ultimately solicit propositions to build the machines in quantities This intention was understood all around. The machines were built, the quality being about equal, and to sample. Wycoff's bill was for three machines, at $40 each; Sackett's bill was for three machines at $67 each. Wycoff had given Mr. Patentee an "estimate" of $40 each, and Sackett's estimate had been $70 each.

It will be noticed that there is considerable difference in these bills, but Mr. Patentee knew something about the machine business and was not disposed to find fault. He knew Sackett's bill was based on cost plus profit and that it would not be lowered, and there was no pressing desire to have Wycoff raise his bill.

He now invited proposals for 5,000 machines. Wycoff bid as follows: "Will make 5,000 machines for $24 each, 100 machines per week, payments weekly." Here is Sackett's bid: "Will make 5,000 machines for $8 each, 1,000 machines per week, payment on completion of order."

If there was anything strange about the bills, there is something stranger about these bids. The two men have about the same capital invested in exactly the same line of business, and their tools are nearly identical, and their shops are not a mile apart.

Wycoff's wanting money weekly is accounted for by the fact that he had no loose capital and could not carry the job. But what caused the difference between 100 machines per week and 1,000 machines per week, and what caused the difference of 200 per cent. in price? I will say, right here, that Sackett got the order and filled it, and has filled several more like it since Knowing the men as I do, I can give the reasons for their great difference in bills and bids. The fact is there is over 200 per cent difference in the men as manufacturers. Wycoff, in the first place, didn't know, when he "estimated" on the samples, what it would cost to build the three machines, he guessed at it. He didn't know what they cost after he did build them, he guessed at that. Guessed he had made money on them, and guessed he could afford to shorten up on the profit on a large order. It happened, however, that the larger order "guessed not." My own opinion is that if he had received the job at $24 each he would have lost money. Around his entire premises there is nothing to show what anything ever did cost, except raw material. It is a good thing, it saves old bills. He keeps books, of course, and knows all about his debts and credits, but nought else.

Now it happens that Sackett, our successful bidder and successful manufacturer, carries in his hat the brains of a systematic manager. His estimate on the first three machines was not guessed at, but was carefully calculated from the nearest parallel cases he could find in his prime cost books. When the machines were done, he found things about as he had expected, and by carefully watching details, had already mapped out his plan of operations and system of production, which would enable him to make these machines in great quantities and at low price. There was nothing surprising to him in the difference between the first three machines, and those he subsequently made; while in Wycoff's case, I do not think there would have been much difference.

The difference between Sackett and Wycoff, as manufacturers, crops out all over. Sackett employs good men at good wages and keeps them. Wycoff employs good men at good wages and can't keep them. There is something in the atmosphere of Wycoff's shop which seems to deprive a man of his self-respect, which is, in reality, the mainstay, sheet-anchor, and only hope of the workingman. Wycoff puts much trust in rules and regulations. You will see a string of them, as long as your arm, as soon as you enter the shop. They are frequent on the walls, supplemented, occasionally, by an enlarged edition of some particular one, thought worthy of a separate frame. One may be noticed with the attractive and endearing legend, "We expect a day's work for a day's pay." Wycoff stole this thing somewhere, for there is no "We" in the concern.

I once saw a body of men on a strike. They had been getting $4.00 for six hours' work, and demanded $6.00 for four hours' work. This was many feet below the bottom of the Mississippi river, where the air was compressed so much that the workmen who were at all damaged by it were thrown into what the bridge hands called the "Grecian bend." When the bent ones straightened out it was often permanently. But, of course, this is not appropriate. Wycoff's men didn't have to work in a compressed atmosphere. Oh no!

Take a trip through his shop. The tools are generally modern and good, but wretchedly kept, and we see no waste that looks as if it would clean anything. Yonder's a chap turning what appears to be a throttle-stem, for it has an elliptic button on one end. He is taking a water-cut over it, and that white lead keg, blocked up on the lathe carriage, bears a striking resemblance to the one we saw over the north grindstone. Those earmarks of grindstone grit make the matter certain. Here's a bench or counter in the middle of the shop, and on it some finished work, a chuck or two, an island of horrible looking waste, half a dozen flat drills and a piece of a twist drill, and here lies a tap, clean and nice, and we pick it up and examine it. We see at once that it is home-made, but it is a beauty, clean-cut and neat. You find it impossible to help admiring this simple tool, for you have made a tap or two yourselves, but none so perfect as this. We lay it down and go on through the shop. Next week you may see the dismembered fragments of our tap in place of its present misplaced perfection.

Here we find Wycoff, coat off and honestly greasy. Yes, he does keep a foreman, or tries to, rather; kings without thrones. "Ah! Mr. Chordal, how do you do? Happy to meet you Mr. Miller, and you Mr. Bailey, excuse my gloves; belong to the laboring classes, you see. Look busy, eh? should think I was; got enough work to—excuse me, gentlemen, got to shrink this crank on." We now notice that just in front of us, on trestles, lies a six inch shaft, with an end projecting. And now, upon the scene, through the blacksmith-shop door come four men, whom I know to be the best paid machinists in the shop, bearing a thirty-inch crank-plate, glowing hot. They quickly place it in position to start on the shaft, and proceed to urge it. From the time Wycoff left us he has not ceased to speak or excitedly yell over this job. We know a single yell will spoil a shrinking fit, but Wycoff, probably don't know it. Now an excited order to one man to go for that block; to this man to raise up; and to that one to let down, "damn it;" now a snub to the man who is really responsible for the job; now he franticly grabs a sledge and strikes a lick or two; now at something else. Every word spoken seems to be immature, every action a false one. We walk on. You remark that Wycoff don't seem to be a cool man, and that if you had any money invested in that crank you would prefer to entrust the job to the jour. whom W. just snubbed, and who seems to have lost all interest in the proceeding, simply looking on with servile disgust.

It's a habit of Wycoff's to take all such jobs into his own hands, generally nipping them in their fruition. The crank was all right, but it is now stuck half way and tomorrow they will try to get it off again.

We go over towards a new engine on the floor, when in come four men with a twelve-foot shaft, red hot. They go over to the long lathe. Up goes the shaft on the blocks; now up on the centers; now it is revolved and gets chalked; and now it comes out and gets pounded and dented, and in two hours it will get straightened. Two hours of what? Lathesman, 60 cents; two blacksmiths, $1.20; one helper, 20 cents; total, $2.00 plus two fires and a lathe standing still, and—those hammer marks.

We go on over to the before-mentioned engine; it's about half done. You ask if Trumbull didn't furnish the castings. No; but he furnished the design. Wycoff's pattern maker measured one of Trumbull's engines and made these patterns from those measurements. There is no drawing in the shop for any part of it, not a memorandum even. The "copy" is in a mill about a mile from here, and Wycoff's foreman has made over thirty trips so far to take a look at details The Lord only knows how many trips it will take to finish it, but we know that it will take just as many for the next engine, and the next. We know what a set of drawings would cost, but no man knows what this engine will cost, or will not cost. We leave it.

Here's a planer, splendid tool! Bement's; but Bement wouldn't recognize it. The table don't look like a planer table at all. Seems as if the prismatic rays from a spectroscope had fallen on this table lengthwise, and on these rays have fallen crosswise; hammer marks, and chisel marks, and sand marks, and water, and oil, and soap, and chips, and dirt. It is not so all over, however, for there a small place has been cleaned, and that new job will soon be fastened there, if Gus can find suitable bolts up among the lathes. You knew Gus when he worked at the Empire Works. He was not such a miserable slouch then; he was a good workman, and you wonder if his skill is not endangered by his present habits. I can tell you, his skill is now a total wreck. He worked for me long ago, and left W. once and came to work for me again. I sent him back. He seemed to be two different men. He gets good pay and will as long as he stays here, but his pride of skill and his self-respect have gone forever.

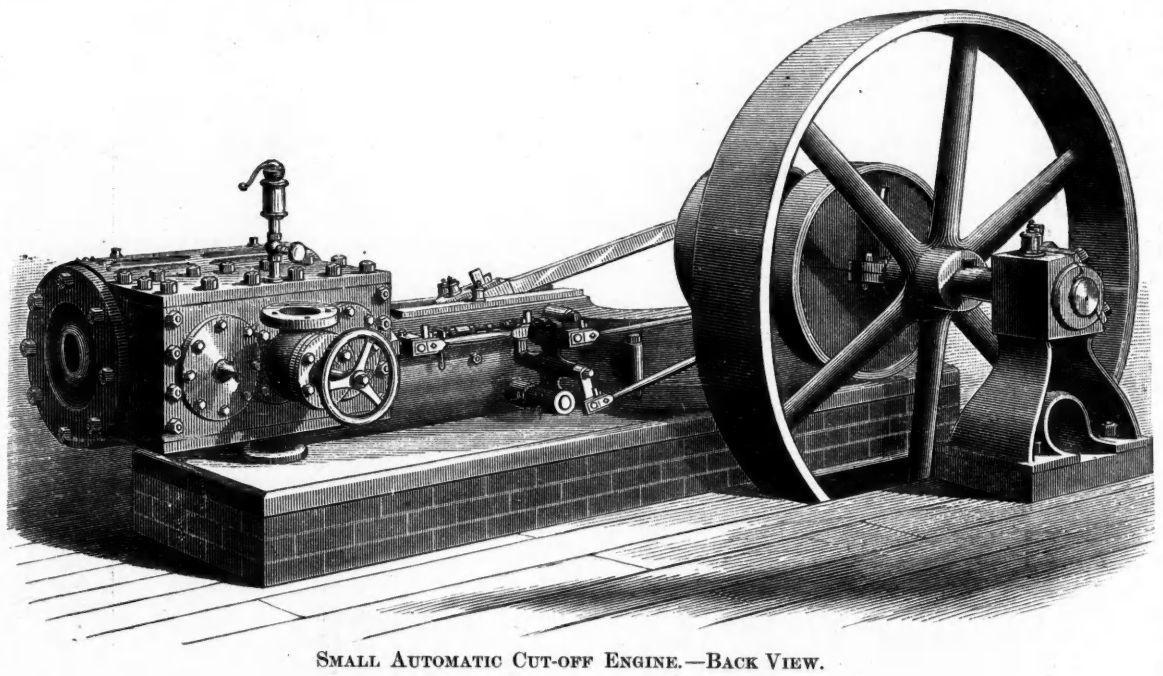
You have an eye for the tool holders or clamps on this planer. Three nuts of one size, and one nut of three other sizes. You look to see what manner of universal wrench Gus uses for a tool wrench. Finally, you spy it; a monkey wrench. Strange, but you hadn't thought of that. Now we go into the foundry. Notice that the only way to get into the foundry is through the machine shop, and the only way for the castings to get out of the foundry is through the machine shop, which we find littered up with lamp posts, grate bars, sash weights, spout guards, in fact, an index to the foundry order book. Here we are in the foundry. Here's a facing mill, and a Sturtevant blower, and a rattler within six feet of it, showing little regard for the lungs of the workmen or the journals of the blower. There's a man cleaning off a sugar mill roller. Know him do you? No, he is not a cleaner, but a well-paid machinist. We see they intend to take off a heat soon; let's go. We don't want to see Wycoff at work in here. He will come in when the iron comes down, will bring the best men out of the machine shop with him, will tap out, and skim, and riotously work mud on the end of the plugging stick, and yell and swear and superintend generally. His foreman is a well-paid man, but helpless. If Wycoff kept cost books he should *credit* the foundry with his services at five dollars per hour.

We go out—past the planers, past the Wycoff engine, past the whole committee on mean ways of straightening shafting, past the half way crank and its pondering factors, past our beautiful tap—out from under the garish rules and into the street.

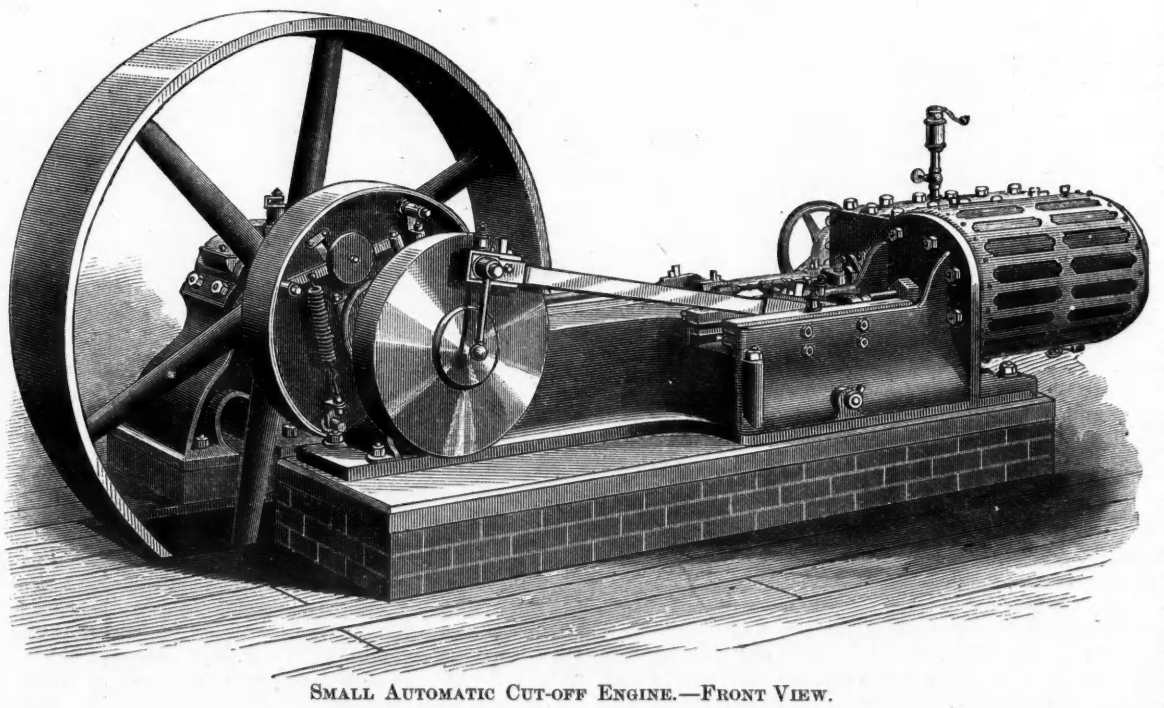
We will see Sackett's shop some time and many times. His interior, his processes, his men, his management, will all furnish material for instructive mention in these letters some day.

Very respectfully,

CHORDAL.



SMALL AUTOMATIC CUT-OFF ENGINE.—BACK VIEW.



SMALL AUTOMATIC CUT-OFF ENGINE.—FRONT VIEW.

Small Automatic Cut-off Engine.

We illustrate on this page the small automatic cut-off Engine from 10 to 40 h. p., built by the Buckeye Engine Co. of 87 Liberty St. These small engines differ from the larger ones only inthe form of bed (see engraving in our May number)the valve motion is the same throughout, consequently equal economical results per h. p. together with close governing, is maintained in both types. We learn they are received with much favor, and are giving excellent satisfaction. There are not a few instances where the ordinary throttling and automatic cut-off Engines having ridicuously light loads, use fully 10 lbs. of coal for each h. p. developed per hour. These small automatics will do the same work with about one-third of that quantity, and the saving of two-thirds or even one-third of our coal bills is of considerable importance in these times of small margins incident to all classes of manufacturing. These engines have the advantage of moderately high piston speed—about 500 ft. per minute—combined with the benefits of using steam expansively and automatic regulation. As they occupy but little floor space compare with the ordinary engine of equal power, and being nicely balanced they are very well adapted for use on upper floors, and wherever room is limited. They are unusually well built, are simple in construction, easily cared for, and fully up to the acknowledged high standard of the Buckeye Engine, now so popular in this market. Two of these engines, one small of 15 h. p. and one of 80 h. p. are now on exhibition at the fair of the American Institute, now open in this city.

New Publications.

We are indebted to Prof. R. H. Thurston for a copy of his REPORT ON COLD ROLLED IRON AND STEEL AS MANUFACTURED BY JONES & LAUGHLIN'S AMERICAN IRON WORKS, PITTSBURGH.

The work contains 109 pages, also a number of double page plates. It embraces the results of very extensive tests to determine the value of cold rolling, the conclusion being that it increases the tenacity from 25 to 40 per cent., and the resistance to transverse stress from 50 to 80 per cent. It also elevates the elastic limit under torsional as well as tensile and transverse stresses, from 80 to 125 per cent. It also improves the metal in several other respects. The work before us will be of especial interest to all those interested in metallurgical manipulations.

THE AMERICAN QUARTERLY MICROSCOPICAL JOURNAL, edited by Romyn Hitchcock; Vol. 1, No. 1, October, 1878.

We have received the first issue of the above quarterly, which is published in the interests of microscopical science. It is a well printed 82-page magazine, with an additional 16 pages devoted to the transactions of the New York Microscopical Society. It is embellished by a number of fine plates, and its articles are the best of their class. Among the articles in the issue before us we notice "The Sting of the Honey Bee," by J. D. Hyatt; "Description of a New Species of Diatoms," by H. L. Smith, and many others. The magazine is published by Hitchcock & Wall, 150 Nassau street, New York.

New Screw-Cutting Lathe.

The engraving herewith represents a new screw-cutting lathe placed upon the market by Messrs. Goodnow & Wightman, 176 Washington street, Boston. The object has been to meet the demand for a first-class tool at a low price, which will do a great variety of work, both in metal and wood, and one that can be depended on for accuracy and durability.

The lathe occupies a floor space of 25 by 36 inches, the centers being 44 inches high from the floor, the whole weight is 266 lbs.; the bed is 35 inches long, 5 inches wide, 3½ inches deep, with double Vs. for carriage and tail stock. It swings 8 inches over bed and 5¾ inches over carriage, and will turn 18 inches long.

The head stock is back geared, and the cone has two speeds for 1¼ inch belt, the smaller being 2½ inches diameter, the larger 5 inches diameter; this, with the back gears give four different speeds, the fastest giving 1100 revolutions of the arbor to 100 of the balance wheel, and the slowest, 75 of the arbor to 100 of the balance wheel; this gives a sufficient range for all kinds of work.

The arbor in head stock is 9 inches long and 1¼ inches diameter in the largest part, and has a ⅝ inch hole through it, which is very convenient for turning the ends of long rods, making small screws, studs, etc. The centers are ½ inch diameter, the screw on end of arbor is 15-16 inch diameter, and has 14 threads to inch. There is an attachment in head stock for reversing the motion of carriage.

The carriage has a rack and pinion for moving it by hand, and a split nut moved by a cam on the face of carriage to throw it in gear with screw; the reversing motion is in head stock.

The tool post has a slot for tools ⅜x1⅛ inches; the tool is adjusted by a wedge made on the arc of a circle and fitted to a convex washer. The leading screw runs the whole length of lathe, and has 10 threads to the inch. A set of gears go with the lathe which will cut all common threads from 8 to 48, and a great variety of other sizes by compounding them; there is a screw stop on the carriage for screw cutting, etc.

The tail stock can be set over for turning tapers, etc. The spindle of tail stock is 15-16 inches diameter, and has a motion of 3 inches. The center is fitted to a taper hole, which is the method adopted by all the best makers, and is the same size as the one in head stock, so that chucks and other tools fitted to one can be used in the other.

The foot motion is claimed to be the best made, the crank is adjustable and the shaft has swivel bearing; the balance wheel is 21½ inches diameter, and has two speeds to match cone on head stock; it weighs about 60 lbs.

To Prepare a Shaft Properly for Turning.

BY J. J. GRANT.

In accordance with my promise, I will give my ideas in regard to the proper method of doing the various kinds of work done in the lathe, beginning at the more simple turning and as fast as space will allow proceed to the more difficult operations.

As the centering of a shaft, or piece of work, is the first operation, and as all subsequent operations are dependent on the centres, it is, of course, necessary that they should be as perfect as possible.

In the first place, *never* turn a piece of work, no matter how short the job, without drilling and countersinking the centres, as the lathe, or male centres, retain their accuracy for a much longer time than when work is done on them without being so made ready.

To centre a piece of work properly it should be, if a long shaft, straightened as near as possible with the eye, which may be done either with a sledge or under a screw press, then with a centre punch, prick as near as possible, and only deep enough to hold on the centres; it can then either be revolved and marked with chalk on the full side, and drawn with the centre punch, or it may be "square centred;" which is done by having a centre ground square, leaving four cutting edges.

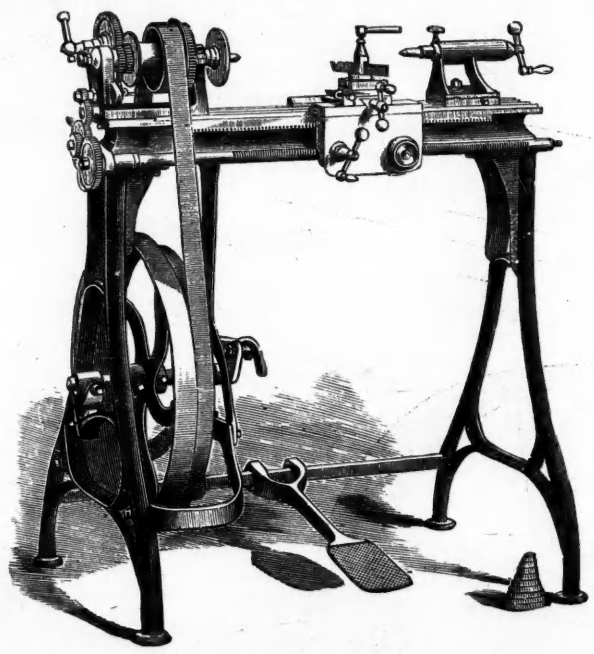
Care should be taken to put the square centre into the tail stock of the lathe, so as to present two cutting edges to the front. A "crotch" tool made in the form of a V at the end of a common lathe tool, having an opening large enough to take in the shaft, is then clamped into the tool post, and set so that the centre of the V is on a level with the lathe centres.

The shaft should be revolved at a speed as fast as practicable, say from fifty to three hundred per minute, according to the size. The crotch tool should be forced against the revolving shaft, and, at the same time, the square centre must be gradually worked in, care being taken not to make the centre too large before the shaft has become true. A little practice will enable a beginner to centre a shaft true and quickly.

Never drill or ream a centre too large or out of proportion with the work, as nothing looks worse to a mechanic than to see centres in a piece of work one-half its diameter.

The size of centre drills for different diameters of shafts should be about as follows:

¼ in.	to ½ in., inclusive,	1/32.
⅝	" 1 " "	1/30.
1¼	" 3 " "	1/8.
3½ in. and above,		5/32.



New Screw-Cutting Lathe.

The largest or outside diameter of the countersink should be about three times the diameter of the drills, but these proportions must, of course, be inversed if the shaft is to run on centres, and not in journal boxes.

Having now centred the shaft, the next operation is to straighten it. There are various appliances for this purpose, but the best is a screw press, made to traverse the bed of the lathe, and in the best make having wedge blocks with a V on the top that can be raised, and also moved close together, or far apart, as the crook in the shaft is short or long.

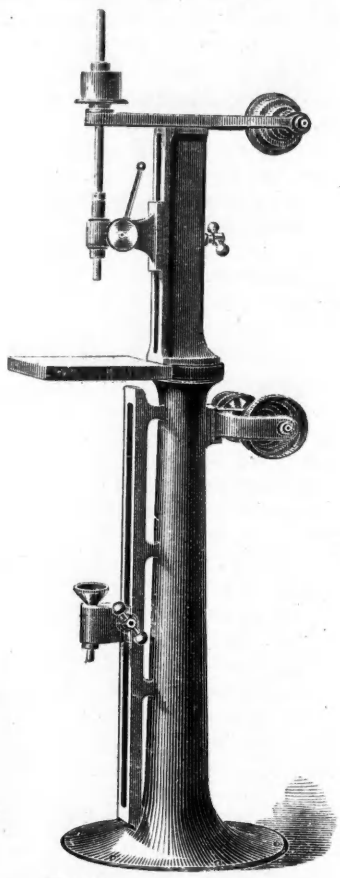
Now, while the shaft is revolving, mark the full side with a piece of chalk every three or four inches for the full length, as by so doing you get the proper place to begin; always straighten the long crooks first. Sometimes it should be bent more than is necessary to bring the exact spot true, as when the full side or crooks are on opposite sides, when by bending the other crooks it will bring it back.

It is always necessary to loosen the centres when using the press; the wedges should only be brought to bear and not forced under the shaft too tight. To become an expert at this part of the work requires long practice, and can only be attained by closely noticing the effect of each blow or strain of the sledge or press upon each part of the shaft. I have seen a shaft, when pronounced finished by a good hand, run as true as a turned shaft.

When we have the shaft properly straightened, it must be squared true with a side tool, and the centres re-reamed with the square centre, care being taken to have the centre *exactly* 60° angle. Drill the centres with the proper sized drill only about ⅛ inch deep, and the shaft is ready for the next operation, which is turning.

The Sensitive Drill.

The accompanying cut illustrates an improved drilling machine designed especially for small drills from 1/16in. diameter to a maximum of 5/16. In connection with the hand lever is an equalizing spring so adjusted as to exactly counterbalance the weight of the spindle and chuck, enabling the operator to determine with the utmost nicety the force actually applied to feeding the drill. Those accustomed to the use of "Pin" drills will readily appreciate the advantage of this device, as it obviates in a great measure that prolific source of loss in the use of small drills, viz., breakage caused by the drop of the spindle when the point of the drill cuts through the stock. On the column beneath the table is a "Bell" centre having a vertical adjustment. By swinging the table to one side this can be used for center drilling. This drill was designed by Mr. Dwight Slate, a well known mechanic, and has been named by him, The Sensitive Drill. Mr. E. P. Bullard of 14 Dey St. New York, is the sole agent for their sale in this city.



The Sensitive Drill.

American Steam Engineering.

The following is taken from an editorial in *Engineering*, of London: In steam engineering we may well premise any remarks made by asserting British superiority in marine and portable steam engines, and to this may be added also a new type, the short stroke compact engines, such as Brotherhood's, Willan's, West's, with others; but our steam engine practice, as a whole, is by no means uniform, and singular to say, that type most important of all, the common stationary engine for driving mills and factories, did not, until within the last few years, if we consider all circumstances, compare favorably with American practice. We well know how many will dissent from this view, yet an impartial examination of the matter cannot fail to show that during twenty years past, not only England, but most countries in Europe, have been following American practice in many leading features.

We need scarcely devote room to prove this. Nearly one-half the steam engines exhibited at Vienna in 1872 were of the American type, that is, with the Corliss or the Allan types of framing, and with either Corliss valve gear or gear of a similar character. The old rectangular box frames were first abandoned in America, while they still retain their hold here with some firms, although they are rapidly being supplanted by better patterns.

In respect to another branch of steam engineering—portable direct-acting-steam-pumps, most of our readers know that nearly the whole of this industry in England, and it is a large one, pays tribute to American inventors.

American Institute Fair.

The 47th Industrial Exhibition of the American Institute is now in progress and attracting crowds of visitors. The machinery department presents many attractions. In wood working tools there are some good exhibits, that of the Smith Machine Co., Smithville, N. J., being especially prominent. First & Pryibil of this city show some of their superior band sawing machines, also shafting, pulleys and hangers. The Buckeye Engine Co. have one of their fine-running automatic engines driving a department of the machinery. Ed. Harrington & Son, of Philadelphia, have a good exhibit of their patent hoists which attract considerable notice. The Brown Caloric Engine Co., 57 Lewis Street, show a hot-air engine in operation. It runs very smoothly and steadily and is well adapted to supplying power. Mr. John G. Avery, of East Brookfield, Mass., exhibits his patent anti-friction and anti-lubricating bearings. The bearing is broken up into a number of little rollers which seem to lessen the friction in a wonderful degree. He has a 1750 lb. balance wheel running by a thread from the shafting without apparent strain. Kelly & Bro., 46 Cortlandt St., show their National Steam Pump in operation, while the emery-wheel business is represented by the Union Stone Co., of Boston, and the Celluloid Emery Wheel Co., of Newark. A large part of the machinery is in motion which adds interest to the exhibits. The arrangements, as a whole, are well planned and reflect great credit on the Superintendent, Mr Chas. Wager Hull, and his able assistants.

The Ross Burr Stone Grinding Mill.

The mill shown in annexed cuts is grinding its way into general use, particularly for the finest work. Many of our largest manufacturers prefer it to any other mill. From the peculiar shape of the grinding surfaces it has a large area of surface near the centre of motion, and its shape—one stone running inside the other, gives it a special adaptation to fine grinding, such as is needed for white lead, coach colors, printers' ink, chocolate, paste blacking, Paris white, mixed mustard, etc., in water, oil, or varnish. Already most of the printers' ink made in this country is ground in Ross mills. This mill is also finely adapted to the grinding of dry materials (run at high motion) such as wheat flour, corn

meal, drugs, spices, dry paints, etc. Mr. Ross has received at different Exhibitions, over 100 premiums over competitors for superiority in the simplicity of the working and economy of power required to operate his mill, receiving from the American Institute, New York, alone, two gold, seven silver and three bronze medals. At the Arkansas State Fair, at Little Rock, October, 1877, highest premium as a wheat and corn mill; also on the best barrel of corn meal ground at Forrest City, Arkansas. This mill is a solid, well-built machine, made entirely of metal and stone of the best quality by skillful workmen.

The grain or dry mill is run at high speed; grinds fine, fast, cool, and dry, and runs with very light power, grinding on the circumference close to the centre of motion instead of on an extended diameter, as is usually the case in other mills; and is consequently a principle in the system of grinding, utterly at variance with the ancient upper and nether millstone. Its utility is very little noticed by millers, who, as a class, know little about the theory of mechanics, but more of their grandfather's practice on the *old-fashioned Burr*. This principle is worthy of thorough investigation, as may be seen from the written certificates submitted to our inspection in praise of the utility of this mill. Fig. 1 represents the mill with mixer attached, by which the materials to be ground may be thoroughly mingled before entering the mill. In grinding paint, the addition of the mixer is considered advantageous; the paint drops cold into the mill, thereby avoiding the heat consequent upon the friction of fine grinding. From a sectional view, Fig. 2, the internal arrangement of the mill will be clearly understood. The contents of the hopper are fed into the stones by the screw A, the mining stone B, shaped like a frustrum of a cone, attached to a vertical shaft which is rotated by the gearing shown; the outer stone is enclosed in an iron casing, and concave to receive the stone B, the internal contact of the surfaces being regulated by the hand-wheel on side of mill, Fig. 1. D is an oil-pipe for oiling upper bearing. The entire construction is simple and strong. For further information address the manufacturer, Mr. Charles Ross, Jr., 81 and 83 First Street, Williamsburgh, New York.

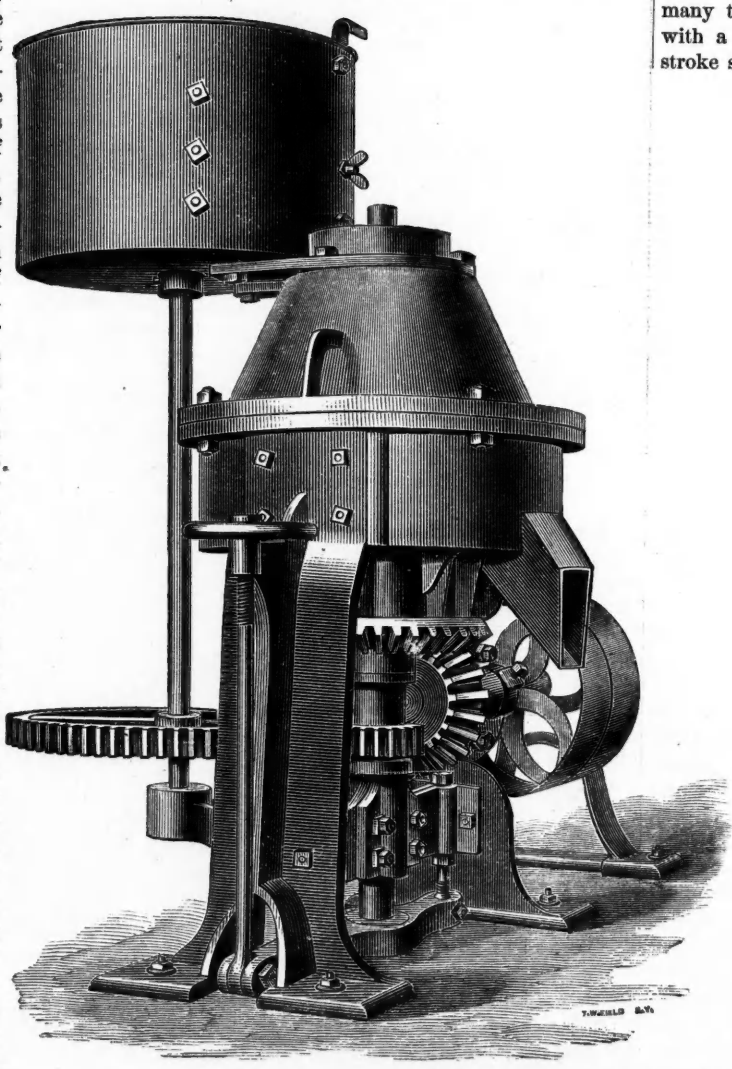


FIG. 1. THE ROSS BURR STONE GRINDING MILL.

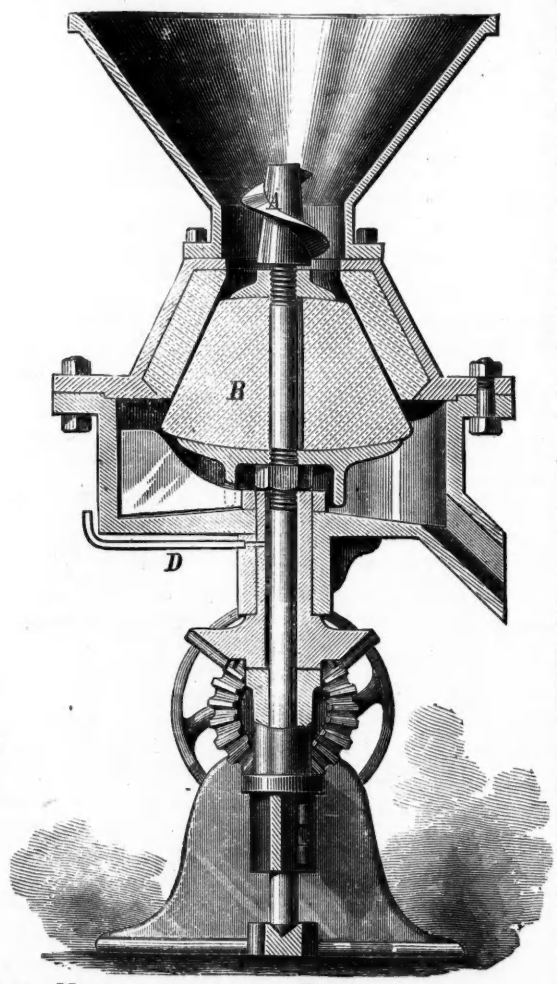
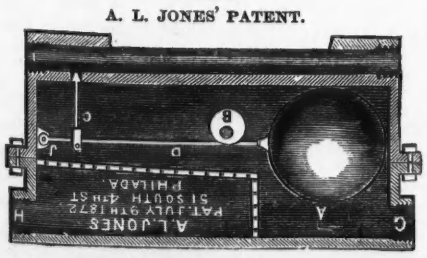


FIG. 2.

Improved Self-Regulating Steam Trap.

A. L. JONES' PATENT.



Herewith is illustrated the Improved Self-Regulating Steam Trap, of A. L. Jones' Patent, with the following explanation. The pipe by which steam enters is screwed in at H, the outlet pipe is at G, for steam connection, to be used only where steam is wanted to be carried further on; the waste or outlet pipe for condensed water to pass out is at either end that is most convenient. Should the steam not be wanted to go further than the trap at G, it is plugged up. It will be seen at once that it is a perfect steam drum as well as a trap; that dry steam can always be had, which makes it a valuable machine for Steam Engines to take the water out of pipe before passing into the cylinder, or for taking water from exhaust pipe after passing the engine, where the steam is wanted for heating, as it takes no power from the engine to force condensed water through the pipes; the condensed water passes in through the pipes at H in conduct or strainer, which catches all refuse, and than into the basin in which is the ball float A. When the water in the trap reaches the hollow rod D, it raises the float, which lifts the stem C from its seat, and the water passes out through the outlet. The hollow rod D is opened at one end into the copper ball or float, and at the other through the side into the open air, so that the great difficulty and objection to hollow balls is overcome by this new and simple invention; any leakage or sweating in the float or ball is instantly evaporated into steam and passes out, which always keeps the float dry and the water at a uniform height in the trap. It is easily seen that it is impossible for any steam to escape; needs no attention whatever, and makes no difference whether one pipe empties into it, or whether you waste a whole factory, it works the same. The faster the water runs in the higher the ball rises and lets the water out, and as the water stops coming in, the ball lowers and closes it up. The handle on the side is a cam or round wheel, with stem in one side, to turn up in winter and let the water all out to prevent freezing; to be used at no other time, unless something gets under the seat of valve. In placing this trap before the public, the inventor does not wish to condemn any other inventor's trap, and makes only one claim on this, and will leave this to be decided by the most scientific engineer or mechanic, or any user of steam; it is simply that this is the only principle on which a steam trap can be made to work itself perfectly and be reliable, and let no steam escape through it. For steamboats, drying rooms, heating pipes in buildings, cylinders, presses, pans and worms in sugar houses, or any place where steam is used, it is invaluable to catch all the condensed steam and return it back where it can be used over again. No water is as good to put into boilers as condensed water. You have not to depend on any one to watch the waste pipe to see if any steam is blowing out to waste; but, on the contrary, open your valves and let your steam in. It matters not whether you have five pounds of steam or a hundred, this machine is the watchman for the end of the pipe, to see that no steam es- capes. This trap has been thoroughly tested, and has proved itself efficient. For further particulars, address, Wm. Kelly & Bro., No. 46 Courtlandt St. New York, who are also manufacturers of the National Steam Pump.

Steam Engine Economy—A Uniform Basis for Comparison.

A PAPER BY CHARLES E. EMERY, M. E., MEMBER OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Continued.

It is still strenuously denied by many that greater economy can be secured with a compound engine than with a long stroke single engine, using the same steam pressure. There are coasting steamers of similar size running regularly in the United States using both types of engine, with, it is claimed, substantially the same results; but the boilers for the single engines are evidently the more economical, making an accurate comparison impossible. Strictly comparative experiments have, however, been made by Chief Engineer C. H. Loring, U. S. N., and the writer with engines of different kinds in the steamers of the United States Revenue Marine, and by the writer with some of those of the United States Coast Survey.

The revenue steamers were of the same size and the boilers very nearly identical. In one steamer was a compound engine with steam-jacketed cylinders; in another, a long-stroke, high-pressure condensing engine (cylinder not jacketed); in another an ordinary low-pressure engine (cylinder not jacketed); and in still another, a high-pressure condensing engine with a jacketed cylinder. The compound engine showed a saving of 12 to 16 per cent. compared with the best performance of either single engine when operated at the same steam pressure. It is believed that substantially the same differences will be found in all cases when equally good engines of both types are compared. The performance of a short-stroke compound engine may be equaled or even excelled by that of a long-stroke single engine, on account simply of the difference in clearance spaces and the superior efficiency of the steam-jacket in the latter case, but by making the compound cylinders in the same form they should still show an advantage. In practice, the economy of marine compound engines is greater than above mentioned, for the reason that the high steam pressure is better maintained with them by the engineers than when single cylinders are used with high rates of expansion, causing difficulties in management.

The following table shows, in line 1, the performance of one of the Leavitt compound beam pumping-engines, at Lawrence, Massachusetts, and in line 2 that of the engines of the *Rush*, one of the revenue steamers previously referred to:

1	90	Approximate Steam Pressure.
2	70	
1	13.75	Ratio of Expansion.
2	6.22	
1	18	Diameter of Small Cylinder. Inches.
2	24	
1	38	Diameter of Large Cylinder. Inches.
2	38	
1	96	Strokes of Pistons. Inches.
2	27	
1	16.27	Revolutions per Minute.
2	70.84	
1	260.3	Piston Speed. Feet per Minute.
2	318.8	
1	22.15	Mean Pressure Referred to Large Cylinder. Pounds.
2	24.48	
1	196.4	Indicated Horse-Power.
2	266.6	
1	14.02	Water per Indicated Horse-Power per Hour. Pounds.
2	18.33	

The comparison is very interesting. In both engines the larger cylinders are of the same diameter, but the difference in the duty for which the engines were designed required great differences in other proportions and in all the details of construction.

To be continued.

THE BRIGGS LATHE.

The Briggs Lathe.

Herewith is illustrated The Briggs Lathe. This lathe will turn a piece of wood or metal 12 inches long and 6 inches in diameter. It can be used with equal advantage for Drilling, Polishing, Sawing, etc. The length of bed is 24 inches; the spindle is made of steel, has a conical bearing, and can be tightened as it wears. The bed, head, tail-stocks, and cone-pulley are of cast iron and the centres of steel. The following pieces are furnished with the lathe: 2 T rests, 1 face-plate, 2 plain centers, 1 spur center for wood, 1 plain drill-chuck, 1 drill-pad, and 1 center left blank to turn down as a fitting for a universal chuck. The bench weighs 81 pounds, is made of iron, with a black-walnut top, and has a driving-wheel measuring 22 inches in diameter, with three grooves for changes of speed. A recent improvement has been made in bench so as to strengthen and beautify the leg, and the back stretcher and treadle has been changed from wood to iron. For prices and furthur information, address the manufacturers, Frasse & Co., 62 Chatham St., New York.

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☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

NEW YORK, OCT. 15, 1878.

The Pawtucket Corliss Pumping Engine.

In our last issue we gave some particulars about the remarkable results shown by the Pawtucket Pumping Engine, designed and built by George H. Corliss, the well-known inventor and builder of the Corliss Steam Engine. We have the further pleasure of laying before our readers, in this issue, facts and figures of especial interest evolved by the trials of that engine, which prove that it has no equal in the world. The excess of contracted duty took all engineers by surprise, and marks a new era in pumping machinery. This engine has been run steadily since the 30th of January last under great disadvantage on account of the non-completion of the reservoir; yet in pumping into the distribution pipes it has, in every instance, amply and nobly stood the test. The two illustrations which we present in the supplement, with this issue, will give a clear idea of the ground plan and side elevation of this engine.

Description of the Pumping Machinery.

The propelling mechanism of this system embodies a fly-wheel, two cranks working at right angles, two upright walking beams, two horizontal steam cylinders, and two horizontal pumps, with their several connections and appurtenances.

The whole arrangement is adapted to the use of steam at the high pressure of 125 pounds to the square inch, which is first admitted into a cylinder 15 inches diameter, 30 inches stroke, and from which it is exhausted into a receiver, and from thence passes into a second cylinder 30 inches diameter, 30 inches stroke, from which it is exhausted into a jet condenser.

The pump plungers, which are keyed to the steam-piston-rods, are each 10.52 inches diameter, 30 inches stroke, and the rods are 2.5 inches diameter.

The steam cylinders, valve boxes and cylinder heads are all thoroughly steam-jacketed.

The induction valves of both cylinders are connected to one lever for hand adjustment, and are also placed under the control of a fly ball governor which limits the velocity of the engine to 52 revolutions per minute.

Each charge of steam admitted into the 15-inch cylinder is expanded about twenty times its original volume before it passes into the condenser from the 30-inch cylinder.

Mr. Corliss' original system of valves and valve mechanism, so widely known, is here combined with the important improvements that were embodied in the Great Engine which furnished the motive power of the Machinery Hall at the *Centennial Exhibition.*

In general terms, we have here Mr. Corliss' mill engine, operated at mill speed, with the fly wheel to insure steadiness to the movements of the pump plungers, the cranks to limit their stroke, and a governor always ready to check the velocity of the machinery in case of a violent change in the water pressure, consequent upon a sudden opening of water gates or a breakage in the distribution pipes.

The steam is furnished by three of Mr. Corliss' Patent Upright Tubular Boilers, each four feet diameter, fourteen feet long, and of the precise form and arrangement of those which furnished steam for the *Centennial Engine.*

Each boiler has a fire surface of 560 square feet, and a grate surface of 19.63 square feet.

The Contract

Between the Pawtucket Water Commissioners and the Corliss Steam Engine Company, provided for tests of the machinery in the following terms:

"One of these tests shall continue 24 hours incessantly, and shall be similar to the Lowell tests of June, 1876,

"The other shall occupy two weeks, omitting the intervening Sunday, running the fires ten hours per day as nearly as may be, with the engine at such speed as shall guarantee the delivery of 3,000,000 gallons in 24 hours. In this 'every-day-running' test, all the fuel shall be taken into account, the wood used for kindling being reckoned at forty-five per cent of its weight in coal. No allowance to be made for ashes or clinkers."

To the ordinary reader these provisions present only a difference of duration of the trials, one being for a single day and the other for a fortnight, but when we read further that a duty of 100,000,000 foot pounds was guaranteed on the 24 hours' trial and only 80,000,000 foot pounds on the two weeks' trial, the difference is too marked to be accounted for on that theory, and we are naturally led to a consideration of the radical difference in the *conditions* of the two tests, and we find that the former commences after the fires are made, and after the grates are well stocked with fuel, and includes only the fuel put into the fire boxes during a run of twenty-four hours, whereas the latter commences with the first kindling of the fires on clean grates and includes all the fuel used during the "every-day 'running" of two weeks.

Of the comparative value of these two modes of conducting tests of pumping machinery, experience has shown that the former has been productive mainly of material for the discussion of experts in their various applications of scientific theories, whereas the latter yields those practical results which furnish a safe basis for estimating the necessary current expenses of a pumping station for the important item of fuel.

Report on Contract Tests.

BY WALTER H. SEARS, CHIEF ENGINEER OF THE PAWTUCKET WATER WORKS, AND ISAAC R. SCOTT, PRESIDENT OF THE WATER BOARD OF WALTHAM, MASS.

To Messrs. S. S. Collyer, Wm. H. Haskell, and Geo. H. Fuller, Water Commissioners, and Geo H. Corliss, Treasurer Corliss Steam Engine Co., Contractors.—Gentlemen:

Section 5th of your contract made April 24th, 1877, is as follows:

5. The engine when completed and ready for service shall be subjected to trial tests for duty and capacity; such trials to be made by the Chief Engineer of the Pawtucket Water Works and his assistants on the part of the party of the first part, with the co-operation of and in concert with such parties as the party of the second part shall see fit to appoint. One of said tests shall continue for twenty-four (24) hours incessantly, and shall be similar to the Lowell tests in June, 1876, with a similar provision in case of disagreement, as specified in Sections 7 and 11 of the "Specifications for a Pumping Engine," heretofore issued by said Water Commissioners. The other shall occupy two (2) weeks, omitting the intervening Sunday, running the fires ten (10) hours per day as nearly as may be, with the engine at such a speed as shall guarantee the delivery of 3,000,000 gallons in twenty-four hours. In this "every-day-running" test all the fuel used shall be taken into account, the wood used for kindling being reckoned as equivalent to forty-five per cent. (45 per cent.) of its weight in coal. No allowance to be made for ashes or clinkers. The coal used in these tests is to be first-class run of the mine, and the quantity of water delivered is to be ascertained by weir measurement.

The undersigned, appointed in accordance with said section, having made the tests as provided for in said contract, hereby present the following report:

The two weeks "every-day-running" test was commenced August 6th, and the computation of the duty for the average of the twelve days is as follows:

Number of hours run,	120
Number of revolutions,	373,124
Average reading of water gauge in pounds,	109.164
Average reading of draft indicator, being distance from centre of water gauge down to surface of water in pump-well, in feet,	16.3169
Average of total head against pump, in feet,	269.0185
Average temperature of water,	78.194°
Weight of a cubic foot in pounds,	62.20625
Displacement of one revolution in cubic feet,	5.6952
Wood used to start fires, in pounds,	2126.5=956.925 coal.
Coal used to start fires in pounds,	6521
Coal used while pumping, in pounds,	26,598.5
Total pounds of fuel used,	34,076.425

DUTY.

5.6952c. ft.×373,124 rev.×62.20625 lbs.×269.0185 ft.×100 / 34,076.425 lbs. coal.

= 104,357,654 foot pounds per 100 lbs coal.

the details of each day are given in the following table:

DAYS.	Number of Hours Run.	Number of Revolutions.	Average reading of Water Gauge, in Pounds.	Average reading of Draft Indicator, in Feet.	Average total Head Against Pump, in Feet.	Wood used to start Fires, in Pounds.	Coal used to start Fires, in Pounds.	Coal Value of Fuel used in starting Fires, in Pounds.	Coal used while Pumping, in Pounds.	Coal Value of total Fuel used, in Pounds.	Duty calculated on Total Fuel used, in Foot Pounds, per 100 lbs. Coal.	Average temperature of Water in Pump Well.
August 6th,	10	30,581	111.248	16.595	274.1674	164	590	593.8	*2,294.5	2,878.3	103,191,770	78.666°
" 7th,	10	31,016	109.404	16.256	269.655	170	499	575.5	2,216.5	2,792.	105,877,530	79.0
" 8th,	10	31,132	110.0758	16.7068	271.5053	164	469	542.8	2,283.	2,825.8	105,973,950	78.0
" 9th,	10	31,979	98.275	16.6324	244.1110	170	527.5	604.	2,041.	2,645.	102,021,290	78.0
" 10th,	10	31,107	110.238	16.0193	271.9179	170	522	596.5	2,217.75	2,816.25	106,132,530	78.5
" 12th,	10	31,262	110.3494	16.3617	272.2892	170	775	851.5	2,471.5	3,323.	96,500,311	78.0
" 13th,	10	31,293	110.154	17.160	272.1334	170	511.5	588.	2,327.	2,915.	107,183,490	77.583°
" 14th,	10	31,961	110.010	16.844	271.5028	227	501	608.15	2,250.75	2,859.	105,359,104	78.166°
" 15th,	10	31,067	110.001	15.610	270.2578	211.5	483	578.175	2,231.5	2,809.675	105,864,460	78.5°
" 16th,	10	30,956	110.228	15.5529	270.7103	170	501	577.5	2,171.	2,748.5	108,021,020	78.0
Thursday, "	10	31,054	110.042	15.5049	270.3239	170	436.5	512.	2,224.	2,737.	108,691,650	78.0
Friday, "	10	31,116	110.087	15.7709	270.4735	170	775.5	862.	2,160.	3,032.	99 345,727	77.666°
Saturday, October 3d,	10	31,116	110.087	15.7709	270.4735	170	775.5	862.	2,160.	3,032.	99 345,727	77.666°
Monday, "	10	31,054	110.042	15.5049	270.3239	170	436.5	512.	2,224.	2,737.	108,691,650	78.0
Tuesday, "	10	30,956	110.228	15.5529	270.7103	170	501	577.5	2,171.	2,748.5	108,021,020	78.0
Wednesday, "	10	31,054	110.042	15.5049	270.3239	170	436.5	512.	2,224.	2,737.	108,691,650	78.0
Thursday, "	10	31,107	110.238	16.0193	271.9179	170	775	851.5	2,471.5	3,323.	96,500,311	78.0
Friday, "	10	31,262	110.3494	16.3617	272.2892	170	775	851.5	2,471.5	3,323.	96,500,311	78.0
Saturday, "	10	31,293	110.154	17.160	272.1334	227	511.5	588.	2,327.	2,915.	107,183,490	77.583°
Monday, "	10	31,961	110.010	16.844	271.5028	201	501	608.15	2,250.75	2,859.	105,359,104	78.166°
Tuesday, "	10	31,067	110.001	15.610	270.2578	211.5	483	578.175	2,231.5	2,809.675	105,864,460	78.5°
Wednesday, "	10	30,956	110.228	15.5529	270.7103	170	501	577.5	2,171.	2,748.5	108,021,020	78.0
Thursday, "	10	31,054	110.042	15.5049	270.3239	170	436.5	512.	2,224.	2,737.	108,691,650	78.0
Friday, "	10	31,116	110.087	15.7709	270.4735	170	775.5	862.	2,160.	3,032.	99 345,727	77.666°
Totals and averages,	120	373,124	109.164	16.3169	269.0185	2126.5	6521.	7477.925	26 598.5	34,076.425	104,357,654	78.194°
Thursday, October 3d.	24	74,463	108.06	16.6706	266.4853	.....	.....	.....	5,272.	5,272.	133,522,060	68.458°

*The coal value of the cinders remaining on August 19th, estimated at 50 per cent., was deducted from total coal used on August 6th.

The weir measurement was made for four hours on August 28th, and showed the capacity of the engine at the average speed of the two weeks' test to be 3,060,000 gallons in twenty-four hours.

The twenty-four-hours' test was commenced on October 3d, at 9 o'clock A. M., and the details and computation of the duty are as follows:

Number of revolutions,	74,463
Average reading of water gauge, in pounds,	108.06
Average reading of draft indicator, in feet,	16.6706
Average of total head against pump, in feet,	266.4852
Average temperature of water,	68.458°
Weight of a cubic foot, in pounds,	62.2882
Displacement of one revolution, in cubic feet,	5.6952
Coal used while pumping, in pounds,	5272

DUTY.

5.6952 c. ft.×74,463 revs.×62.2882 lbs.×266.4852 ft.×100 / 5272.

= 133,522,060 foot pounds per 100 lbs of coal.

Several other trials of the duty were made, the details of which will be presented in a more extended report to be made hereafter.

The results show that the engine has exceeded the guarantee on the two weeks' "every-day running" test by more than 30 per cent., and on that of the twenty-four hours' test by more than 33 per cent.

In presenting this report we congratulate both parties to the contract, the contractor on having so successfully designed and built, and the Commissioners on the part of the town on having obtained a pumping engine unequaled for the economical use of fuel. Respectfully submitted,

WALTER H. SEARS,
ISAAC R. SCOTT.

PAWTUCKET, R. I., October 7th, 1878.

About Ourselves.

With this issue the AMERICAN MACHINIST becomes one year old. In this age of rash ventures, when newspapers go up like rockets and come down like sticks, it is a source of satisfaction to be able to chronicle the first year's successful progress. Last November, when we sent forth our first issue, many of our friends shrugged their shoulders and spoke dubiously of its solid establishment. They essayed to point out to us what a weak foundation an independent machinery journal had to rest upon, and the necessity of starting up a patent-right bureau, a "machinery purchasing agency," a bookselling department, or some other auxiliary to keep it alive. We firmly refused to depart from the principles laid down at the start, being fully determined that if we could not carry them out as proposed that we would relinquish the whole business to some one that could. The result, however, has been very gratifying. Machinery manufacturers being convinced of our sincerity in producing a candid, independent representative journal of the machinery interest, came to the support of the AMERICAN MACHINIST with an energy that left us no doubt of the success of its mission. Subscriptions came pouring in from every State in our Union, and from many foreign countries. An increasing news-stand trade was developed, not only for current

numbers, but for months past we have been besieged for back numbers. We gathered around us a corps of worthy contributors who are familiar with the subjects of which they treat, and who have stamped their individuality upon our columns not soon to dwindle away.

Having reached a regular edition of 7,000 copies, we feel assured of a continued success and hereby return our thanks to our patrons, one and all, who have so nobly sustained us in our efforts.

With this issue, which completes the first year of our existence, we have the pleasure of presenting in advance of our contemporaries a large supplement with engravings of the Great Pawtucket Corliss Pumping Engine, and a report of its trial, which showed the most wonderful results ever achieved in the world; far surpassing all other waterworks pumping engines.

Cutting Prices—A Vicious System.

The machinery trade of this country has met, and is still passing through one of the most trying ordeals that could have beset it. Many prominent houses have had to succumb, and others have found it necessary to suspend operations until a more auspicious season. Still others have nobly fought their way onward and won renewed honors in their steady and unflinching manner of conducting business. Another class of machinery makers we shall have to designate *trimmers*, because it is the only word that appropriately expresses our meaning. Let the fact stand out in bold relief, that no man buys a machine now-a-days because it is cheap. Ridiculously low prices do not effect sales. When an article is needed it is bought, of course, at the lowest obtainable price. But Mr. A. B. C. and D. go to work and cut the life right out of the one chance when it does come. They thin their patterns past all usefulness. Mr. A. shortens his profit, then B. takes his all off, then C. cuts wages 10 per cent. and consolingly tells the men there is no money in business. Then, of course, D. cuts wages 20 per cent. and justifies himself by saying there's no money in business. After all there is only one job done. No strength in the metal, no profit for the builder, no decent pay for the men. When cuts commence on wages, suggested by the low price at which stuff must be sold, *there is no end to it.* The workman deals in force. He keeps it to sell, and a surplus stock on hand is, under some circumstances, dangerous. The American machinist is imposed upon shamefully. He is forced to submit to the present plan of pricing products, and pays for his board the same amount he did five or six years ago, when his wages were double their present allowance.

It is time this vicious system of shaving down prices was consigned to the relics of a bygone era. It produces no profit to the manufacturer, nor to his workmen. It advances the reputation of neither. It demoralizes the trade. What possible benefit the purchaser obtains we fail to see. Let him make a thorough test of the quality of his new machinery and he will most likely heartily condemn the unpropitious system. We believe a reaction is not far off, that those who have been making machinery at any price to secure customers will shortly find that customers are to be secured at *no price* because they have gone after their machinery where they can be assured of obtaining a first-class article at a fair price for the same.

Marine Boiler Explosions.

The frequency of explosions on steamboats and steam-tugs whose boilers are inspected and passed by the U. S. inspectors at this port, calls for the most thorough research into the causes of such disasters in order that they may be prevented. The recent Adelphi explosion by which a number of people lost their lives, shows the necessity of a searching investigation into the working a system of official inspection that permits certificates to be issued upon such a boiler as she carried. The testimony of experts and boiler makers agree that the boiler was badly corroded, patched, and unsafe to use. Yet this boiler was inspected and passed by the U. S. Government inspector at New York. The inspector has been suspended, but the system that allows certificates to be granted to such boilers still continues. The method of Government inspection consists in filling the boiler with water and applying a pressure. If the boiler does not leak, it is passed. The explosions of tug-boat boilers have lately averaged one a week. In our next we propose to review the Government system of in spection and its results.

Selling Machinery.

The business of selling machinery ought to be conducted like any other mercantile business, and let us assume that in most cases it is. However, there have been arts and artifices worked into machinery trades that cast nothing but discredit upon their participants. When the purchaser is an individual or private firm there is but little room for irregularity, but when the purchaser is a corporation, there are numerous side issues played upon to affect the trade. Illegal commissions are at times resorted to, and other secret arrangements that would not bear public criticism. Occasionally, exposure dries up some well-concerted plans and sends their authors adrift, followed by popular indignation, but the field is well occupied by others who flourish in spite of the chances of detection. In selling engines and boilers, there are good consulting engineers whose opinions are often sought for and followed. But their opinions are not always disinterested. In some instances, they "whack up" with the manufacturers, a thing which the innocent purchaser is supposed to know nothing about. We speak of this, not as a common system, but one that requires careful attention. There is no good reason why machinery should not be sold with the same openness and assurance that characterizes any trade, and with a decided stand by manufacturers against subterfuges, this could generally be carried out. Tricks are often resorted to by hangers on to obtain commissions on machinery sales. In this city there are men who hang about hotels to get access to machinery purchasers as they arrive from the country, and, after learning what they intend to order, go to the place of anticipated purchase and pave the way for a commission. Experienced machinery dealers can avoid such sharks, but many are taken in by them.

MANUFACTURES.

NEW YORK.

The Ellis Foundry Company of South Carver, N. Y., have sold fifteen thousand stove spiders this year.

The Hall Manufacturing Co., 23 Dey St., New York, have just completed arrangements for the manufacture of their Prentiss' Patent Adjustable Jaw and Swivel Bottom Vises, by the old and well-known firm of Bagley & Sewell, General Machinists, of Watertown, N. Y., whose high reputation is a sufficient guarantee of superior workmanship in that desirable implement.

Mr. A. R. Whitney is erecting the section of the New York Elevated Railroad contracted for by him at the rate of 75 tons per day, and expects to have the work finished to Harlem river by December 31. The grand car depot for the joint use of the two elevated railway companies, in course of erection near the upper extremity of the line will be ready for business promptly on time.

CONNECTICUT.

The Pratt & Whitney Company, of Hartford, Conn., have shipped to England last month, for use by a watch tool company, a planer, 20-inch by 9-feet engine lathe with latest modern improvements, including arrangements for cutting screw threads to the metric standard, and a wire straightening machine. Also, to Mexico, a 16-inch by 6 feet engine lathe with taper attachment; an upright drilling machine with index for gauging the depth of holes, drill chuck, twist drills, etc.

D. A. A. Buck, of Waterbury, Conn., who is connected with the Benedict and Burnham Manufacturing Company, has made a diminutive steam engine, which is described as follows: The engine rests upon a gold dollar, and weighs 15 grains, troy weight. It is a horizontal engine, with boiler, governor and pump, containing 148 parts of gold and silver, fastened together with screws, 48 in number, the largest of which is 1-80, and the smallest 1-100 of an inch in size. The bearings are supplied with turned oil cups. It has a safety valve, and all the valves and gearing found on a large engine, and all work admirably. Three drops of water will fill the boiler to its proper capacity. The size of the cylinder is 1-16 of an inch, and length of stroke, 3-32.

MASSACHUSETTS.

The Fitchburg Steam Engine Co. received an order for a 10-inch cylinder (rated 20 H. P.) engine on Sept. 21. They commenced on the stock for it Sept. 24, and completed the engine, ready for shipping, Oct. 2., just eleven days from the receipt of the order. They had to order every ounce of stock and did not run any over-time, working only eleven men on the job.

The Compressed Shafting Co., Hill, Clark & Co., Selling Agents, Boston, exhibit at the Mechanics Fair, in that city, a new article of shafting. It is claimed that by their process they compress the whole body of the iron with an even and exact pressure attainable in no other way, giving a uniform fibre through the whole substance, ensuring a sound and perfect condition of the material, and at the same time a perfect finish and exact size. Finished iron and steel rods are produced in the same way, also flat, ovals hexagon, and all regular and irregular shape, of finished iron and steel.

MAINE.

The large machine shop near the Augusta, Maine, dam, has been rebuilt, and is being stocked anticipating commencing work this month.

NEW JRESEY.

Hewes & Philips, of Newark, have recently begun making printing presses in addition to their other specialties.

PENNSYLVANIA.

J. Naylor & Co., People's Works, Philadelphia, have just completed a 100 H. P. engine, for the Midvale Works.

G. & H. Barnett, Black Diamond File Works, Philadelphia, are running full time and employing 65 hands. They report business improving.

Wm. Sellers & Co., of Philadelphia, have taken the bulk of the recent order from New South Wales for fine machine tools, amounting to some $25,000.

Corydon Winch, of Philadelphia, manufacturer of bar iron, spikes, and general railway supplies, is busy, with good prospects for the coming winter. He is at present employing 125 men.

The Latrobe Car Works are building for the Pittsburg, Newcastle & Lake Erie Railroad, 20 eight-wheel ballast cars, 20 box cars, 20 drop-bottom coal cars, and two baggage cars. The first-named lot have already been delivered.

Chas. W. Ervien & Co., Philadelphia, are building up quite a trade on the Pacific coast, having recently made shipments of their engines to California, and are now at work on another for that locality. They are now employing 25 to 30 hands, and report business fair.

The Erie City Iron Works have built this year more boilers than before in any one of the twenty-five years of their existence. The number built up to September 1st was 350, and orders were received for 400 all told. Their export trade is 25 per cent. in advance of last year, and New York trade is more than double.

The Phœnixville Bridge Works have secured another good contract from the Canadian Government railroad, known as the Montreal, Quebec, Ottawa and Occidental Railway, and will build eight bridges in all, as follows: One, of a 215-feet span, over the Ottawa river; four, of 150-feet span, two, of 100 feet each, and one of 80 feet. They are all to be completed between the date of contract and the middle of December.

OHIO.

Smith, Vaile & Co., of Dayton, Ohio, have just shipped two of their large steam pumps to the Louisville & Nashville Railroad.

WISCONSIN.

The Malleable Iron Company at Milwaukee, Wis., has been consolidated with a newly-organized steel company, the two combining a capital of $50,000, in shares of $100 each. They are building two frame shops, 40x100, 50x100 feet, for the increase of business.

Business Specials.

Thirty cents a line for each insertion under this head.

The Pratt & Whitney Co., of Hartford, Conn., make a specialty of Cutters for the teeth of gear wheels, that are shaped entirely by machinery and will make interchangeable all gears that are cut with cutters of the same pitch.

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Frasse & Co., 62 Chatham Street, N. Y. have the most complete assortment of Machine Screw Taps for Machinists, Gunsmiths, Sewing Machine Manufacturers and others, of any house in this country. Also a full line of Chucks, Twist Drills and Fine Tools of every description.

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The Norcross Steam Damper Regulator, the only reliable pressure Governor in the world, manufactured by The Laflin manufacturing Co., Westfield, Mass.

Address Star Tool Co., Providence, R. I., for Screw Cutting Engine Lathes of 13, 15, 18 and 21 in. swing.

Questions and Answers,

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) L. O. C., Louisville, Ky., says, Will you please answer through the AMERICAN MACHINIST if there is a U. S. Standard for builders, and what the standard is to the following engine lathe centres: The working ends or points, also ends fitting in lathe spindles, also counter-sinks for wood and metals and upright drill presses, their sockets for ends fitting into the drill press spindle and the taper for round shank drills, per degree, or per inch? A. The working ends of a lathe centre are universally 60 deg. The taper and the upright drills are the same as the taper of lathe. The tapers in use for twist drills are the Morse and the Manhattan Fire Arms Co. The former is mostly in use, and will probably become the standard.

For the other things mentioned above there is no standard taper. Every maker has his own. They vary from ⅜ inch. to ⅞ inch. to the foot.

(2) G. J. F. Chattanooga, Tenn., asks how he can harden cast or German steel plow molds ¼ inch thick, to make them of even temper and hard as possible? A. It will probably be difficult to harden the metal without retorts, but possibly the following method, if carefully conducted, will answer: Coat the metal with prussiate of potash mixed with flour paste. When it is dry, cover it with clay to keep the potash from coming off, and heat to a bright red.

(3) J. H., Newark, N. J., asks how to fasten rubber belting to wood? A. Paint the wood with white lead in oil and let it dry. Stick the rubber on with glue.

(4) R. S., Boston, asks how to solder gray cast iron? A. Use a solder formed of two parts of tin and one part of lead. The iron may be heated in a naked fire. Use a flux of salammonia with common rosin.

(5) M. R. W., Philadelphia, wants to know how to coat an iron cylinder with emery? A. First paint your cylinder with a good body of white paint, and when perfectly dry and hard, apply your glue and emery.

(6) A. A. F. Indianapolis, asks for a way to get rid of dust in cleaning castings? A. Provide your tumblers for cleaning castings with hollow shafts, say four inches in diameter, closed at one end and well perforated inside the tumbler, and attach a suction fan to the open end, and a discharge pipe leading out to the open air, it will answer the purpose of getting rid of the dust.

(7) W. M. E., Peekskill, N. Y., writes for a bath, or solution for tempering steel? A. Water, 1 gallon; spirits of nitre, 1 oz.; Salammoniac, 1 oz.; white vitrol, 1 oz.; alum, 2 oz.; table salt, 8 oz; saltpetre, 1 oz.; lard oil, 1 pint. Taps and dies should be heated to cherry red and drawn to light blue; wood tools drawn to copper color.

(8) L. R., Baltimore, wants to know if there is any way to clean lubricating oil that has become mixed with tobacco dust? A. Filter it through cotton waste, keeping warm during the operation.

Machinists' and Engineers' Supplies.

Trade is fair, but not very lively. The quantity of goods sold is large, but prices are not, as a rule, satisfactory. The tendency is towards an advance. Mr. F. B. Norton, of Worcester, has issued a new price list of his Emery and Corundum Wheels. The scarcity of corundum has rendered the supply of wheels of that material very small, but a supply has now been obtained and the wheels are furnished as desired. The Allen governor is being improved, which is calculated to make it even more efficient than before. The Compressed Shafting Co., Hill, Clarke & Co., Agents, of Boston, have issued a price list of their new patent Compressed Shafting. This is a new article in the trade and is attracting considerable attention. By their process the whole body of the iron is compressed with an even and exact pressure attainable in no other way, giving a uniform fibre through the whole substance, ensuring a sound and perfect condition of the material, and at the same time a perfect finish and exact size.

Barnes' Adjustable Pipe Tongs have just been presented to the public by the M. E. Frog Co., of New Haven, Conn. They have a quick adjustment, are simple in construction and very durable. The Seibert Cylinder Oil Cup Co., of Boston, has been organized for the manufacture and sale of N. Seibert's Steam Engine Lubricating Cup. A new Oiler and Feed Indicator has lately been brought out, designed particularly for marine and locomotive engine cylinders. The price, including indicator, reservoir, valves, &c., is $40, and it is sold subject to a trial of 30 days, after which, if not satisfactory, it may be returned.

Boiler-Makers Supplies.—Trade has improved considerably since our last and is likely to continue better. Prices are not yet satisfactory, but the tendency is towards appreciation. We quote as before: Tank Iron @ 2¾; C, No. 1, @ 3; Shell @ 3¼; Best Flange @ 4½; Soft Patch @ 6½; Boiler Rivets @3¾; Boiler Tubes list price less 40% discount. Mill prices furnished on application.

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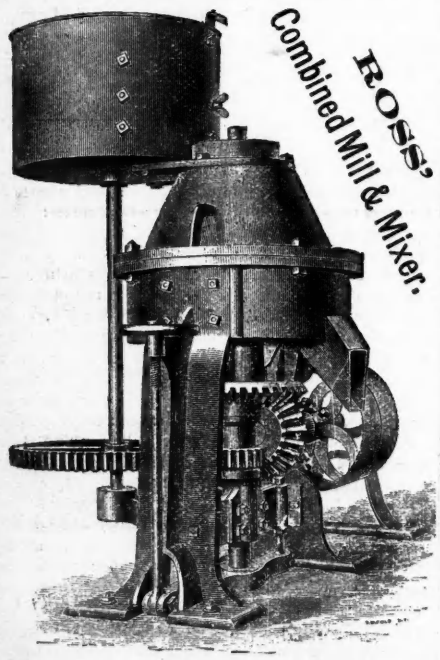

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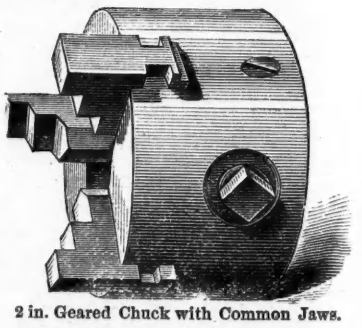

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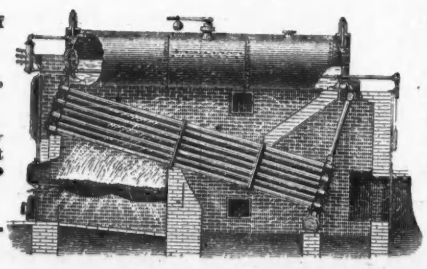

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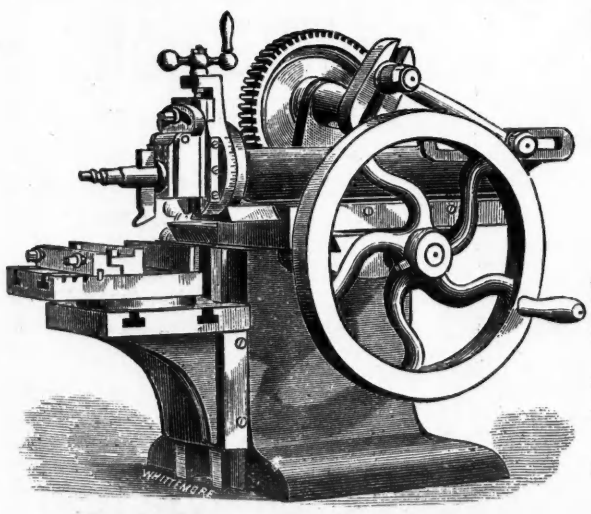

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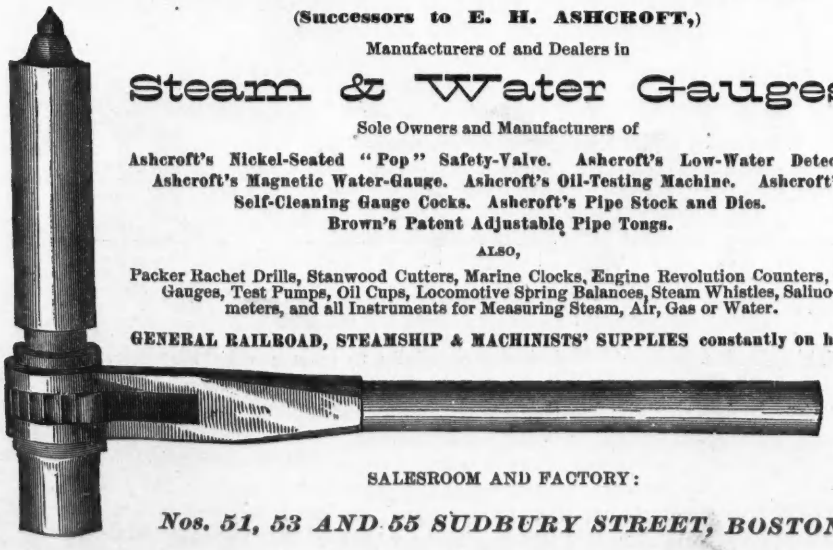

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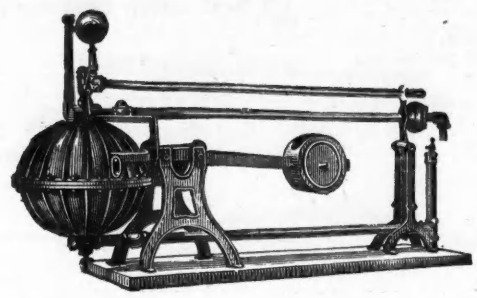

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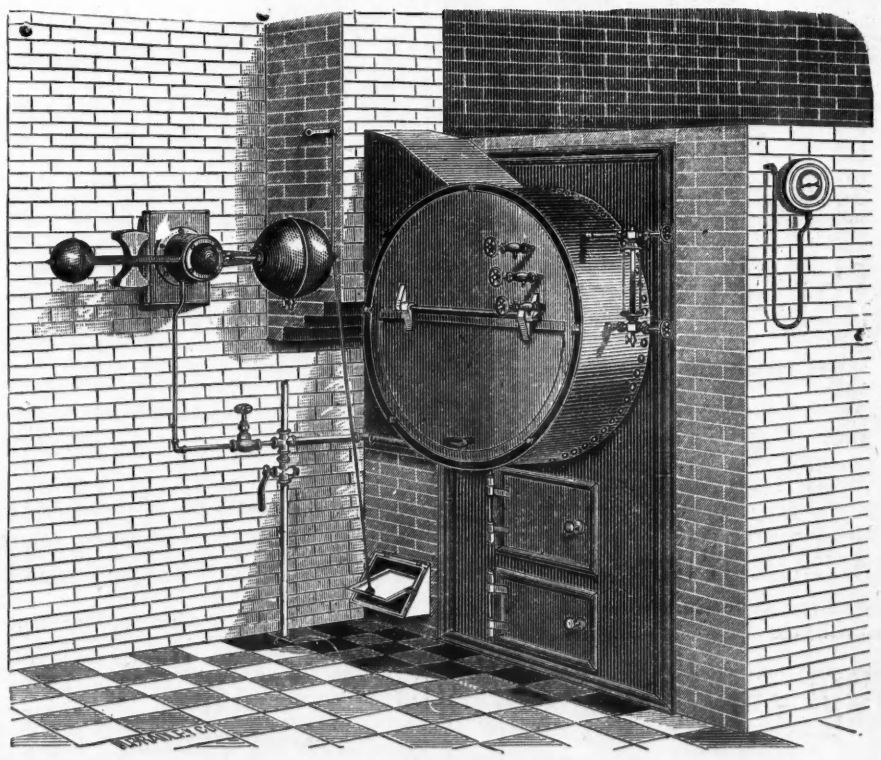

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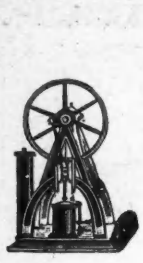

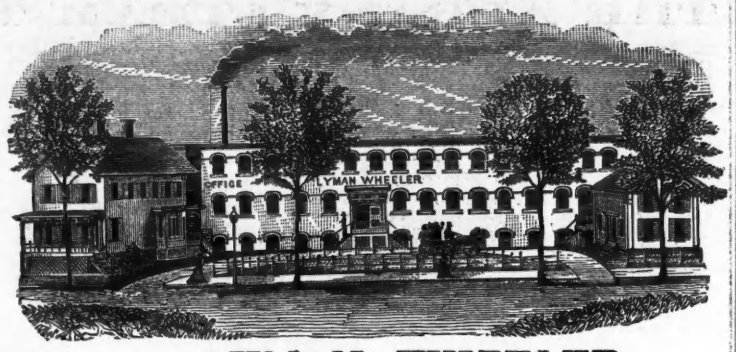

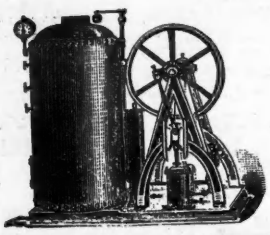

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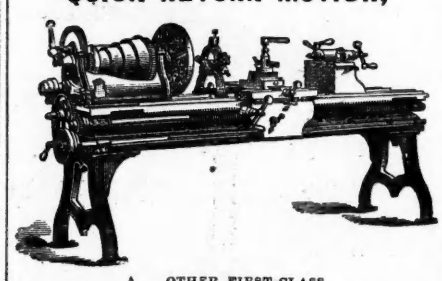

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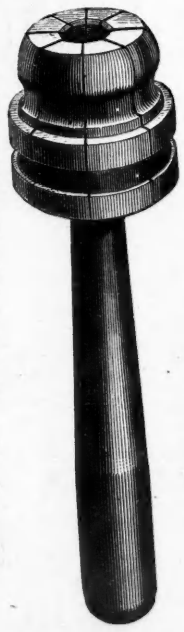

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Larger sizes in proportion.

These tools are portable, and easily worked by one man; handles are reversible, and can be adjusted to run by foot power. The Punching Machines are furnished with the patent SPIRAL PUNCH, which does not mutilate the iron and requires less power. The Flange Punch, "Screw Punch" and "Railroad Punch"—for 1⅛ in. hole in railroad bar—are the most perfect tools in the market.

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Independent Air Pump & Condenser

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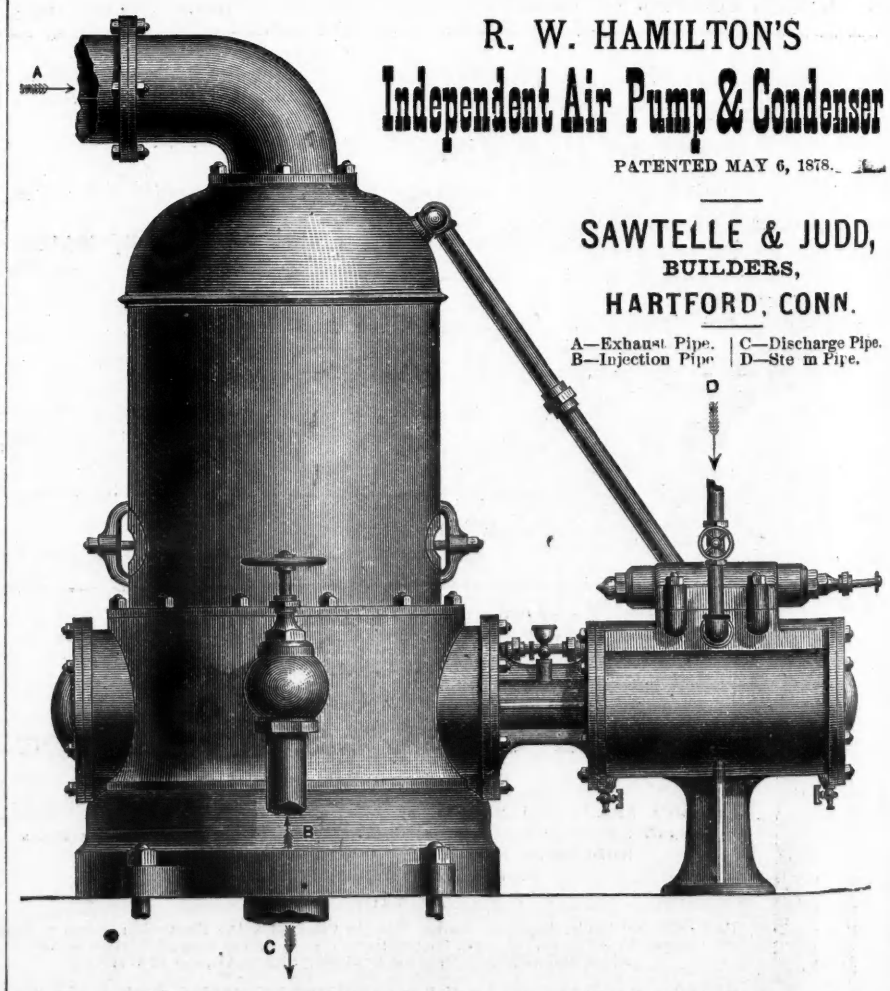

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This Condenser has been designed especially to meet a want long felt for something capable of being readily applied to non-condensing engines, to economize fuel or add to the power. In applying this Condenser to engines now located, it is only necessary to choose the most convenient place for water connections and lead the exhaust to it. By its application we guarantee an increase, in most cases, of 30 per cent. in power, or where that is not desired, 20 to 25 per cent. in fuel saved. A great reduction in boiler pressure may be obtained where increase in power is not required, and this is very desirable in some cases.

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	Price Per Lb.
1×⅜ to 6×1 Flat,	1 8/10
1½ to 6×¼ and 5/16 Flat,	2
1 and 1½×¼ and 5/16 Flat,	2
¼ and 2 Round and Square,	1 8/10
⅝ and 11/16 " "	2
½ and 9/16 " "	2

REFINED IRON.

1×⅜ to 6×1 Flat,	2
1 to 6×¼ and 5/16 Flat,	2 5/10
¼ to 2 Round and Square,	2
2¼ to 2⅞ " "	2 5/10
3 to 3½ " "	2 4/10
3⅝ to 4 "	2 7/10
4⅛ to 4½ "	3
4⅝ to 5 "	3 3/10

RODS, ROUND AND SQUARE.

2 1/10	2 2/10	2 6/10	2 8/10	3	3 1/10	4 2/10

⅝ & 11/16	½ & 9/16	7/16	⅜	5/16	¼	8/16

Ovals, Half Ovals and Half Rounds.

2 6/10	2 8/10	3	3 5/10	3 7/10

¼ to 2	⅝ & 11/16	½ & 9/16	7/16	⅜

BAND.

1 to 6×3/16 to No. 12,	2 4/10

HOOP.

5 8/10	4 4/10	3 6/10	3 4/10	3 1/10	2 9/10	2 7/10

½	⅝	¾	⅞	1	1⅛	1¼ & up'ds

HORSE SHOE.

¼×⅜ to 1⅛×⅝	3 2/10

SCROLL.

4 8/10	4 8/10	4 8/10	3 8/10	3 6/10	3 4/10

⅛×16	14	12	10	3/16	¼ & 5/16
4 2/10	3 8/10	3 5/10	3 3/10	3 1/10	2 9/10
⅛×16	14	12	10	3/16	¼ & 5/16
3 4/10	3 3/10	3	2 9/10	2 8/10	2 7/10
⅛×16	14	12	10	3/16	¼ & 5/16
3 3/10	3 1/10	2 9/10	2 8/10	2 7/10	2 6/10
⅛×16	14	12	10	5/16	¼ & 5/16

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Norway Bar Iron,	5
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Boiler Plate,	2⅝ @
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PIERSON & CO. keep in stock a full assortment of this well known extra brand.

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¾ to 2 Round and Square, 1¼×⅜ to 4½×1,	3 5/10c.

Extras on Rounds and Squares.

¼	1 8/10	⅜ and 11/16	2/10
5/16	1 1/10	2⅛ to 2⅜	3/10
⅜	1/10	2½ to 3	4/10
7/16	6/10	3¼ to 3½	6/10
½ and 9/16	5/10	3¾ to 4	5/10

Extras on Flats.

1 8/10	1 1/10	8/10
5/8×⅛ and 3/16 1 1/10	¼ and 5/16 8/10	⅜ to ½ 6/10
¾×⅛ and 3/16 8/10	¼ and 5/16 6/10	⅜ to ⅝ 4/10
⅞×⅛ and 3/16 4/10	¼ and 5/16 3/10	⅜ to ¾ 2/10
1×⅛ and 3/16	¼ and 5/16	⅜ to ⅞

4/10	3/10	2/10
1⅛×⅛ and ⅜	¼ and 5/16	⅜ to 1
1¼ to 4½×¼ and 5/16, " ×1⅛ to 2		3/10
4¾ to 6×⅜ to 1 4¾ to 6×¼ and 5/16 " ×1⅛ to 2 6½ to 7×⅜ to 1 2¼ to 3×2⅛ to 2¾ 6½ to 7× ¼ and 5/16 " ×1⅛ to 2 3¼ to 4×2⅛ to 3		4/10

Ovals.

8/10	6/10	4/10	3/10
½ and 9/16	⅝ and 11/16	¾	⅞ & up.

Half Ovals and Half Rounds.

1 3/10	1 1/10	8/10	4/10
½ and 9/16	⅝ and 11/16	¾	⅞ & up.

Ulster Horse Shoe,	3 5/10
Esopus " "	3 4/10

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" Toe Calk Steel,	6
" Machinery Steel,	9
Bessemer Wire Rods,	3½
American Bessemer Tire Steel,	
" 3-16 up,	4½c
" " " " 5-32 up,	4¼
" " " " 1-8 "	5
" " " " 3-32 "	5¼
" Spring Steel,	5
" Tool Steel,	13
" Machinery Steel,	6
" Toe Calk Steel,	4½
" Plow Steel,	6
" Sleigh Shoe Steel,	4
" Bessemer Steel,	5½
" Steel Crowbars,	6

STEEL FORGINGS TO ORDER.

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The market is firmer for all kinds and grades of Iron, and this improvement will, in all probability, be maintained. Old rails have advanced fully one dollar per ton. New rails have also been advanced at mills with the prospect of higher figures still a little later on. The demand for Hoops and Bands has been better, and for these, as also for bars, the mills are obtaining full recent advances. The improvement is also felt in Boiler Iron and Supplies, which are in more request.

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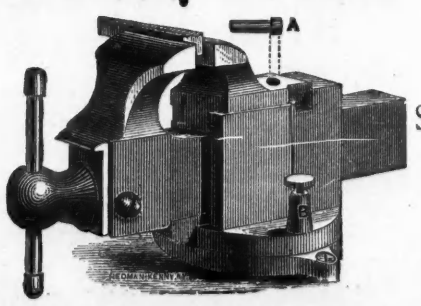

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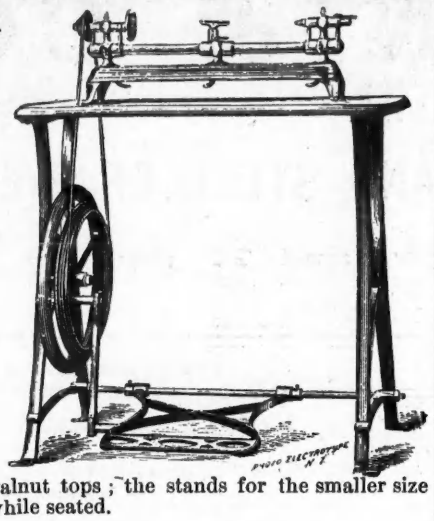

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They are Artistic in Design,

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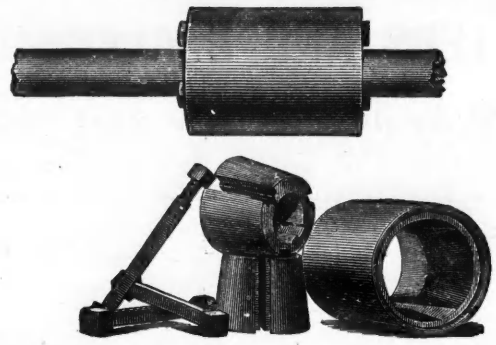

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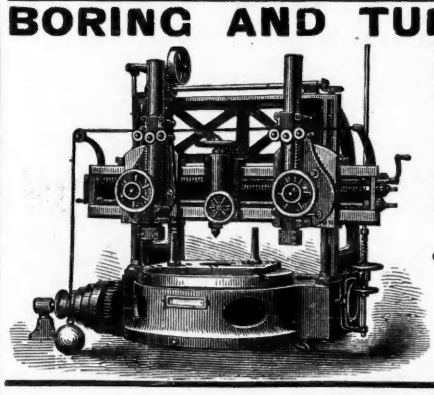

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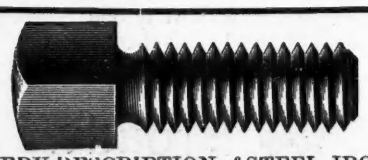

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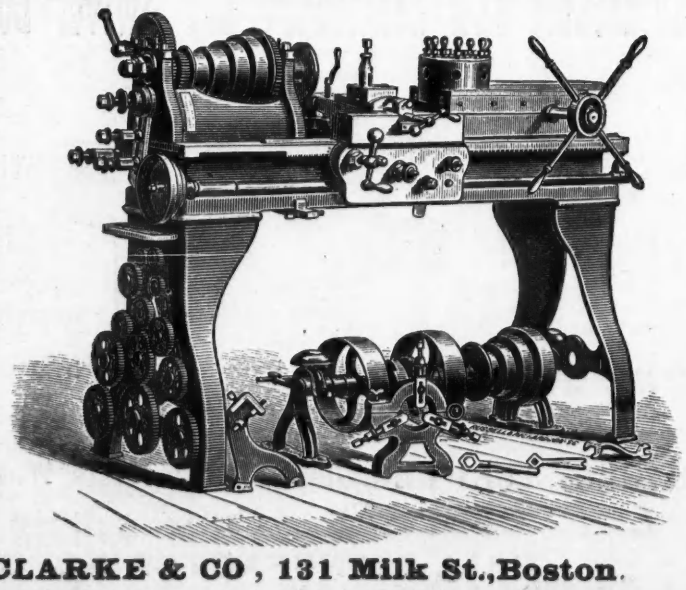

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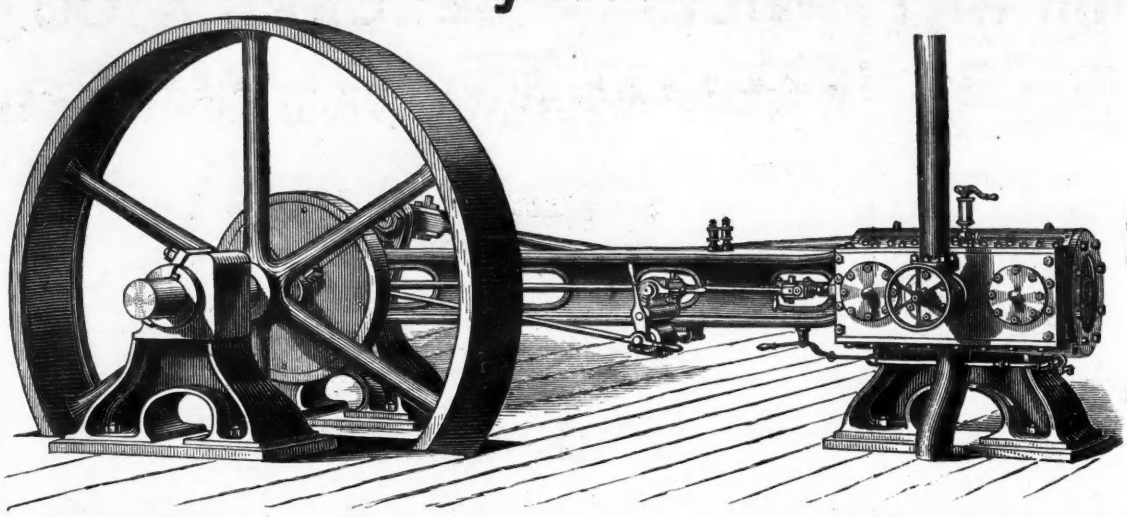

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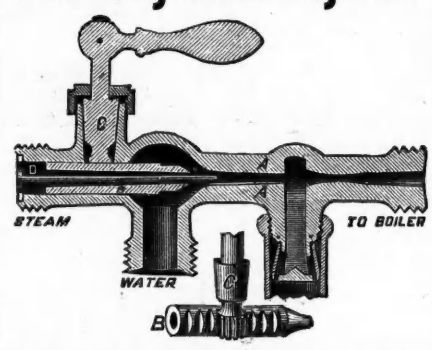

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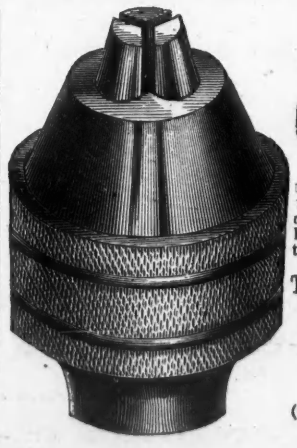

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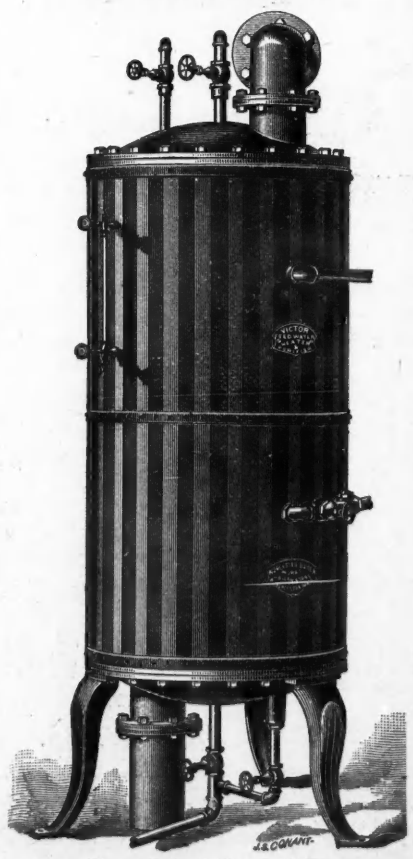

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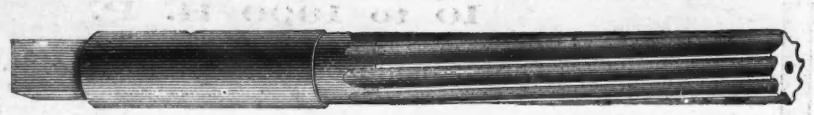

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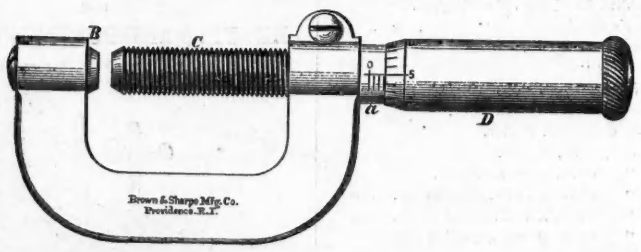

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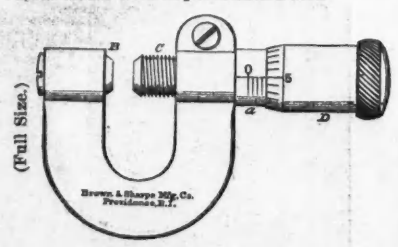

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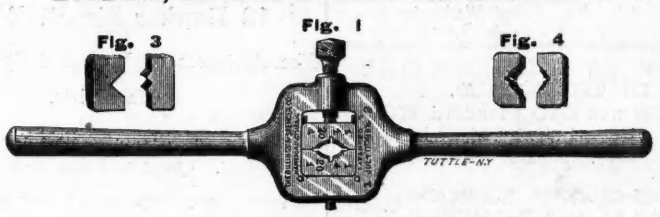

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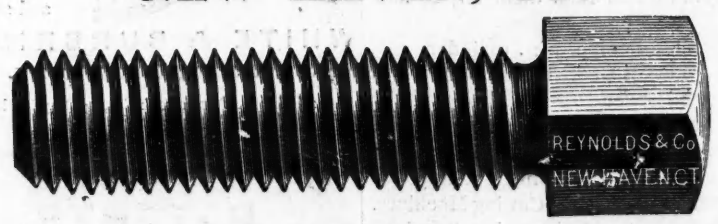

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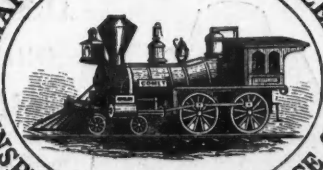

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